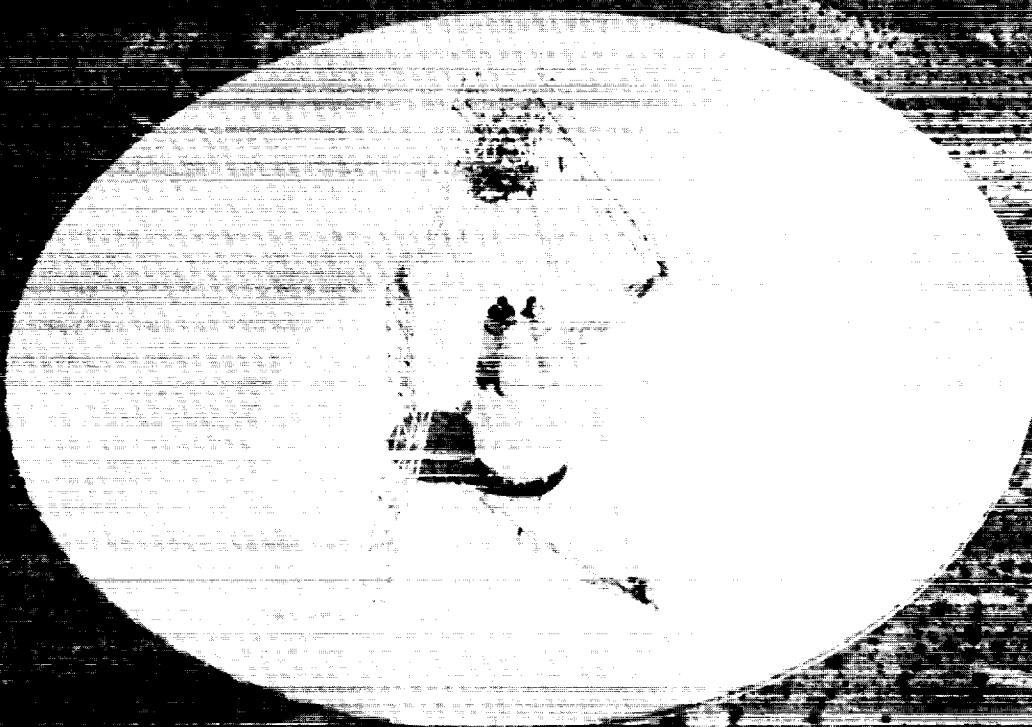


# Environmental Projects: Volume 8

## Modifications of Wastewater Evaporation Ponds



Goldstone Deep Space Communications Complex

**JPL**

Jet Propulsion Laboratory  
California Institute of Technology

**NASA**

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16. Abstract <p>The Goldstone Deep Space Communications Complex (GDSOC), located in the Mojave Desert about 45 miles north of Barstow, California, and about 160 miles northeast of Pasadena, is part of the National Aeronautics and Space Administration's (NASA's) Deep Space Network, one of the world's largest and most sensitive scientific telecommunications and radio navigation networks. The Goldstone Complex is managed, technically directed, and operated for NASA by the Jet Propulsion Laboratory (JPL) of the California Institute of Technology in Pasadena, California.</p> <p>Activities at the GDSOC are carried out in support of seven parabolic dish antennas. These activities may give rise to environmental hazards: use of hazardous chemicals, asbestos, and underground storage tanks as well as the generation of hazardous wastes and the disposal of wastewater. Federal, state, and local laws governing the management of hazardous substances, asbestos, underground storage tanks and wastewater disposal have become so complex there is a need to devise specific programs to comply with the many regulations that implement these laws.</p> <p>In support of the national goal of the preservation of the environment and the protection of human health and safety, NASA, JPL and the GDSOC have adopted a position that their operating installations shall maintain a high level of compliance with these laws.</p> <p>One of the environmental problems at the GDSOC involved four active, operational, wastewater evaporation ponds designed to receive and evaporate sewage effluent from upstream septic tank systems. One pair of active wastewater evaporation ponds is located at Echo Site, while another operational pair is at Mars Site.</p>					
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October 15, 1989

**TO: Recipients of Goldstone Environmental Protection Reports**

The Office of Telecommunications and Data Acquisition (TDA) at JPL is publishing a series of reports that describes several environmental projects at the Goldstone Deep Space Communications Complex (GDSCC). A report will be issued as each project in the Goldstone Environmental Protection Program is completed.

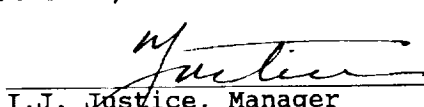
The three-fold objectives of these reports are:

- 1) To provide Goldstone Maintenance and Operations personnel with details of task implementation.
- 2) To serve as a basis for the documentation of environmental activities at Goldstone, as required by regulatory agencies.
- 3) To provide prototype samples of reports that can be referred to by other organizations that may be planning similar environmental protection and compliance projects.

The planned TDA reports include the following:

<u>Volume Number</u>	<u>Compliance Task</u>	<u>Approximate Issue Date</u>
1	Polychlorinated Biphenyl (PCB) Abatement Program (GDSCC)	Issued
2	Underground Storage Tanks - Compliance Program (GDSCC)	Issued
3	Environmental Compliance Audit: Final Report (GDSCC)	Issued
4	Asbestos Survey (GDSCC)	Issued
5	Part One: Study of Subsurface Contamination (GDSCC) Part Two: Guide to Implement Environ- mental Compliance Programs	Issued
6	Environmental Assessment: New 34M Antenna at Venus Site (GDSCC)	Issued
7	Environmental Resource Document (GDSCC)	Issued
8	Modifications of Wastewater Evaporation Ponds (GDSCC)	Issued
9	Construction of Hazardous Materials Storage Facilities (GDSCC)	11/01/89
10	Environmental Assessment: New 34M Antenna, Apollo Site (GDSCC)	1/01/90
11	Environmental Assessment: Addition to Operations Bldg., Mars Site (GDSCC)	2/03/90
12	Asbestos Abatement (GDSCC)	4/01/90
13	Modification of Underground Storage Tanks (GDSCC)	6/01/90
14	Environmental Assessment: One Megawatt Transmitter, Mars Site (GDSCC)	8/01/90
15	Contaminated Soil/Debris Removal (GDSCC)	10/01/90

If additional copies, information, or details are desired, contact Len Kushner, TDA Safety and Environmental Protection Engineer, telephone (818) 354-1844, FTS 792-1844.

  
I.J. Justice, Manager  
TDA Resources and Safety

# Environmental Projects: Volume 8

## Modifications of Wastewater Evaporation Ponds

Goldstone Deep Space Communications Complex



## ABSTRACT

The Goldstone Deep Space Communications Complex (GDSCC), located in the Mojave Desert about 45 miles north of Barstow, California, and about 160 miles northeast of Pasadena, is part of the National Aeronautics and Space Administration's (NASA's) Deep Space Network, one of the world's largest and most sensitive scientific telecommunications and radio navigation networks. The Goldstone Complex is managed, technically directed, and operated for NASA by the Jet Propulsion Laboratory (JPL) of the California Institute of Technology in Pasadena, California.

Activities at the GDSCC are carried out in support of seven parabolic dish antennas. These activities may give rise to environmental hazards: use of hazardous chemicals, asbestos, and underground storage tanks as well as the generation of hazardous wastes and the disposal of wastewater. Federal, state, and local laws governing the management of hazardous substances, asbestos, underground storage tanks and wastewater disposal have become so complex there is a need to devise specific programs to comply with the many regulations that implement these laws.

In support of the national goal of the preservation of the environment and the protection of human health and safety, NASA, JPL and the GDSCC have adopted a position that their operating installations shall maintain a high level of compliance with these laws.

One of the environmental problems at the GDSCC involved four active, operational, wastewater evaporation ponds designed to receive and evaporate sewage effluent from upstream septic tank systems. One pair of active wastewater evaporation ponds is located at Echo Site, while another operational pair is at Mars Site. The clay embankment linings of these wastewater evaporation ponds had been so seriously degraded by erosion that the linings no longer protected against the seepage of sewage effluent into the surrounding soil. Such seepage is prohibited by both county and state ordinances dealing with the proper disposal of wastewater.

Thus, Engineering-Science, Inc. (E-S), Pasadena, California, was retained by JPL to prepare a Preliminary Engineering Report and an Environmental Assessment Report dealing with the repair of the interior embankments of the four wastewater evaporation ponds. In addition, E-S was retained as the engineering firm to design the renovation of the wastewater evaporation ponds and to oversee the construction work concerned with repair of the pond-embankments.

This report deals with the work undertaken to repair the four operational wastewater evaporation ponds. Repair work was begun in December 1988 and was completed in May 1989 and all four wastewater evaporation ponds now comply with ordinances dealing with the proper environmental treatment of wastewater.

A fifth, inactive and abandoned sewage treatment plant and wastewater evaporation pond, located at Mojave Base Station, is scheduled to be demolished and removed early in 1990. The site will then be restored to an environmentally acceptable condition.

## GLOSSARY

BLM	U.S. Bureau of Land Management
CAC	California Administrative Code
CWA	Clean Water Act
DHS	Department of Health Services (State of California)
DSCC	Deep Space Communications Complex
DSN	Deep Space Network
DSS	Deep Space Station
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
E-S	Engineering-Science, Inc., Pasadena, California
FONSI	Finding of No Significant Impact
GCF	Ground Communications Facility
GDSCC	Goldstone Deep Space Communications Complex
HEF	High-Efficiency (Antenna)
JPL	Jet Propulsion Laboratory
LRWQCB	Lahontan Regional Water Quality Control Board
MBGA	M.B. Gilbert Associates, Long Beach, California
MTF	Microwave Test Facility
NASA	National Aeronautics and Space Administration
NEP	North Evaporation Pond (Echo Site)
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NOCC	Network Operations Control Center
NTC	National Training Center (U.S. Army)
NWEP	Northwest Evaporation Pond (Mars Site)
O&M	Operation and Maintenance
R&D	Research and Development
RWQCB	Regional Water Quality Control Board
SEEP	Southeast Evaporation Pond (Mars Site)
SEP	South Evaporation Pond (Echo Site)
SF	Square Feet
SPC	Signal Processing Center
STS	Space Transportation System (Space Shuttle)
TDS	Total Dissolved Solids

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## SECTION I

### INTRODUCTION

#### A. BACKGROUND

The Goldstone Deep Space Communications Complex (GDSCC) is part of the National Aeronautics and Space Administration's (NASA) Deep Space Network (DSN), one of the world's largest and most sensitive scientific telecommunications and radio navigation networks. The Goldstone Complex is managed, technically directed, and operated for NASA by the Jet Propulsion Laboratory (JPL) of the California Institute of Technology in Pasadena, California. The primary purpose of the DSN is to support the tracking of both manned and unmanned spacecraft missions and to provide instrumentation for radio and radar astronomy in the exploration of the solar system and the universe.

Activities at the GDSCC operate in support of seven parabolic dish antennas, at five sites called Deep Space Stations (DSSs): four DSSs are operational in the DSN, while one is devoted to research and development (R&D) activities. There also are four, similar, operational DSSs in Spain and in Australia. Thus, the overall NASA DSN consists of a worldwide network of 12 operational DSSs. An eighth parabolic dish antenna at Goldstone is operated by the National Oceanic and Atmospheric Administration (NOAA). A more detailed description of the GDSCC is presented in Section II.

#### B. WASTEWATER MANAGEMENT AT THE GDSCC

Operation and maintenance (O&M) of the various sites at the GDSCC involve numerous and diverse activities that could lead to possible environmental problems. Some of these activities are the proper treatment and discharge of wastewater to evaporation ponds, and the proper maintenance of the wastewater evaporation ponds.

Wastewater management is important at the GDSCC because the recently amended Clean Water Act (CWA) provides a Federal mandate to protect the waters of the United States from pollution. Regulations have been promulgated by the Environmental Protection Agency (EPA) to provide detailed requirements of the law. The Federal program provides for a state to administer its own program for surface and ground water. The State of California has enacted the Porter-Cologne Water Quality Control Act to enforce the Federal CWA.

California state regulations for management of wastewater are administered by the State Water Resources Control Board through nine Regional Water Quality Control Boards. The particular Regional Board, with jurisdiction over the GDSCC, is the Lahontan Regional Water Quality Control Board (LRWQCB). The LRWQCB is responsible for the issuance of Waste Discharge Requirements that specify operating conditions and reporting requirements for wastewater management facilities at the GDSCC (see Appendix A).

## C. WASTEWATER REGULATIONS

Regulations promulgated in support of Division 7 of the State Water Code, which relate to operation of the GDSCC sewage treatment plants and evaporation ponds, are found in the California Administrative Code (CAC) Title 23. Domestic sewage treatment plants are regulated under subchapter 9 of Title 23. General requirements are as follows:

1. Requirements for a Report of Waste Discharge (CAC Title 23, Subchapter 9, Sections 2205-2207)

A report concerning waste discharge and an application form must be filed with the Regional Water Quality Control Board (RWQCB) for discharges from domestic sewage treatment plants. Upon consideration of the report, and if water quality guidelines are achieved, the RWQCB will issue waste discharge requirements referred to as a permit for plant operations. Wastewater discharge systems must have the required permit for them to operate.

2. Definition of a Material Change (CAC Title 23, Subchapter 9, Section 2210)

Material changes in the character, location, and volume of the wastewater discharge must be reported to the RWQCB. This also includes any change in process, treatment, or disposal method, or a substantial increase in wastewater flow above the permitted quantity. It must be reported if a facility is closed, or if a discharge is discontinued.

3. Monitoring Program Reports (CAC Title 23, Subchapter 9, Section 2230)

Regional boards specify requirements for periodic laboratory analysis, inspections, recordkeeping, and reporting as part of a facility's wastewater discharge requirements. A facility must submit the results of any monitoring program to its regional board at least once per year. Analyses must be conducted by a laboratory certified for such analyses by the State Department of Health Services (DHS).

4. Periodic Review of Wastewater Discharge Requirements (CAC Title 23, Subchapter 9, Section 2232.2)

Every 5 years, the LRWQCB is required to review the GDSCC's wastewater discharge requirements. Any modification to the discharge requirements may be made at this time.

5. Inspections (CAC Title 23, Subchapter 9, Section 2234)

At least once every 5 years, the LRWQCB is required to inspect the sewage evaporation ponds.

#### D. THE WASTEWATER SITUATION AT THE GDSCC

There are four, functioning, on-site, wastewater evaporation ponds at the GDSCC. Two are located at the Echo Site while the other pair is at the Mars Site. The wastewater evaporation ponds are designed to receive and evaporate effluent from upstream septic tanks. The overall normal mode of operation at the Echo and Mars Sites is as follows:

- (1) All wastewaters flow from the site buildings through pipelines to septic tanks.
- (2) After passing through the septic tanks, a very small portion of the effluent flow is directed to leach lines to provide sufficient moisture to allow the soil to function as an electrical grounding field. The major portion of the effluent, however, is discharged to the wastewater evaporation ponds.
- (3) For an extended period of time, usually about a year, all effluent flow from the septic tanks to the wastewater evaporation ponds is directed only to one of the pair of wastewater evaporation ponds. After that time, the flow of effluent then is redirected to the other wastewater evaporation pond of the pair. The wastewater in the pond that then is not in use is allowed to evaporate until that pond is dry.
- (4) Septic tanks are pumped as necessary (by an outside contractor), and the waste is transported to an approved, licensed landfill for disposal.

The wastewater systems at the GDSCC have operated very well since they began service in the late 1950s and early 1960s. Over the years, however, the clay surfaces that line the inside slopes of the wastewater evaporation ponds have become seriously eroded by wind, precipitation, wave action, rodent burrowings, and penetrations by the roots of weeds. Thus, the pond-embankments no longer functioned as a water-impervious barrier to constrain the effluent wastewater within the wastewater evaporation pond.

If this situation were not remedied, the damage to the existing pond liners would continue and sewage effluent could seep into the unprotected soil. It is even possible that over an extended period of time, the embankments could erode enough to allow the septic tank effluent to escape the wastewater evaporation pond not only by seepage, but also by flowing directly through breaches in the failed embankments.

To prevent the escape of effluent from the wastewater evaporation ponds, JPL retained Engineering-Science, Inc. (E-S), Pasadena, California, to prepare a Preliminary Engineering Report dealing with the problem of how best to repair the eroded embankments of the wastewater evaporation ponds. The report was submitted by E-S to JPL in December 1987.

In April 1988, E-S submitted an Environmental Assessment to JPL that documented the existing conditions, analyzed the environmental effects, and presented mitigation measures for the proposed modifications to the four functional wastewater evaporation ponds at the GDSCC. The Environmental

Assessment concluded that the proposed actions to repair the embankments of the wastewater evaporation ponds would have no significant adverse impacts on the GDSCC environment.

In July 1988, E-S submitted the final Engineering Design Drawings, including calculations and specifications, that described in detail the work that was necessary to repair the eroded embankments of the wastewater evaporation ponds.

The Preliminary Engineering Report, the Environmental Assessment, and the Engineering Design also dealt with the closure, demolition, and removal of an unused, abandoned, sewage treatment plant and wastewater evaporation pond at Mojave Base Station at the GDSCC.

This present report deals with the work undertaken to modify the four functioning wastewater evaporation ponds and their embankments. Repair work was begun in December 1988 and was completed in May 1989 and all four, operational, wastewater evaporation ponds now comply with ordinances dealing with the proper environmental treatment of wastewater.

## SECTION II

### THE GOLDSTONE DEEP SPACE COMMUNICATIONS COMPLEX (GDSCC)

#### A. LOCATION OF THE GDSCC

The Goldstone Deep Space Communications Complex (GDSCC) is located in southern California in a natural, bowl-shaped depression in the Mojave Desert, in San Bernardino County about 40 miles northwest of Barstow, California, and about 160 miles northeast of Pasadena, California, where the Jet Propulsion Laboratory (JPL) is located.

As indicated in Section I, the GDSCC is part of the National Aeronautics and Space Administration's (NASA) Deep Space Network (DSN), one of the world's largest and most sensitive scientific telecommunications and radio navigation networks. The Goldstone Complex is managed, technically directed, and operated for NASA by the Jet Propulsion Laboratory of the California Institute of Technology in Pasadena, California.

The 52-square-mile Goldstone Complex lies within the western part of the Fort Irwin Military Reservation (Figure 1). A Use Permit for the use of the land was granted to NASA by the U.S. Army. The Complex is bordered by the Fort Irwin Military Reservation on the north, east and southeast, the China Lake U.S. Naval Weapons Center on the northwest, and state and Federal lands managed by the U.S. Bureau of Land Management (BLM) on the south.

#### B. FUNCTIONS OF THE GDSCC

After the Space Act of 1958 had accelerated U.S. plans and programs for space exploration, JPL initiated construction work at Goldstone to build the first tracking station of what is now known as the Deep Space Network (DSN). Thus, for more than three decades, the primary purpose of the DSN has been and continues today to support the tracking of both manned and unmanned spacecraft missions and to provide instrumentation for radio and radar astronomy in the exploration of the solar system and the universe.

As indicated above, in addition to its participation in numerous scientific explorations, Goldstone performs the following functions in support of DSN operations:

- (1) Tracking: Locating the spacecraft, measuring its distance, velocity and position, and following its course.
- (2) Data Acquisition: Gathering information coming in from the spacecraft.
- (3) Command: Sending of instructions from the ground that guide the spacecraft in its flight to the target. Commands also tell the spacecraft when to perform required operations, including the switching on and off of instruments for performance of the mission's scientific experiments.

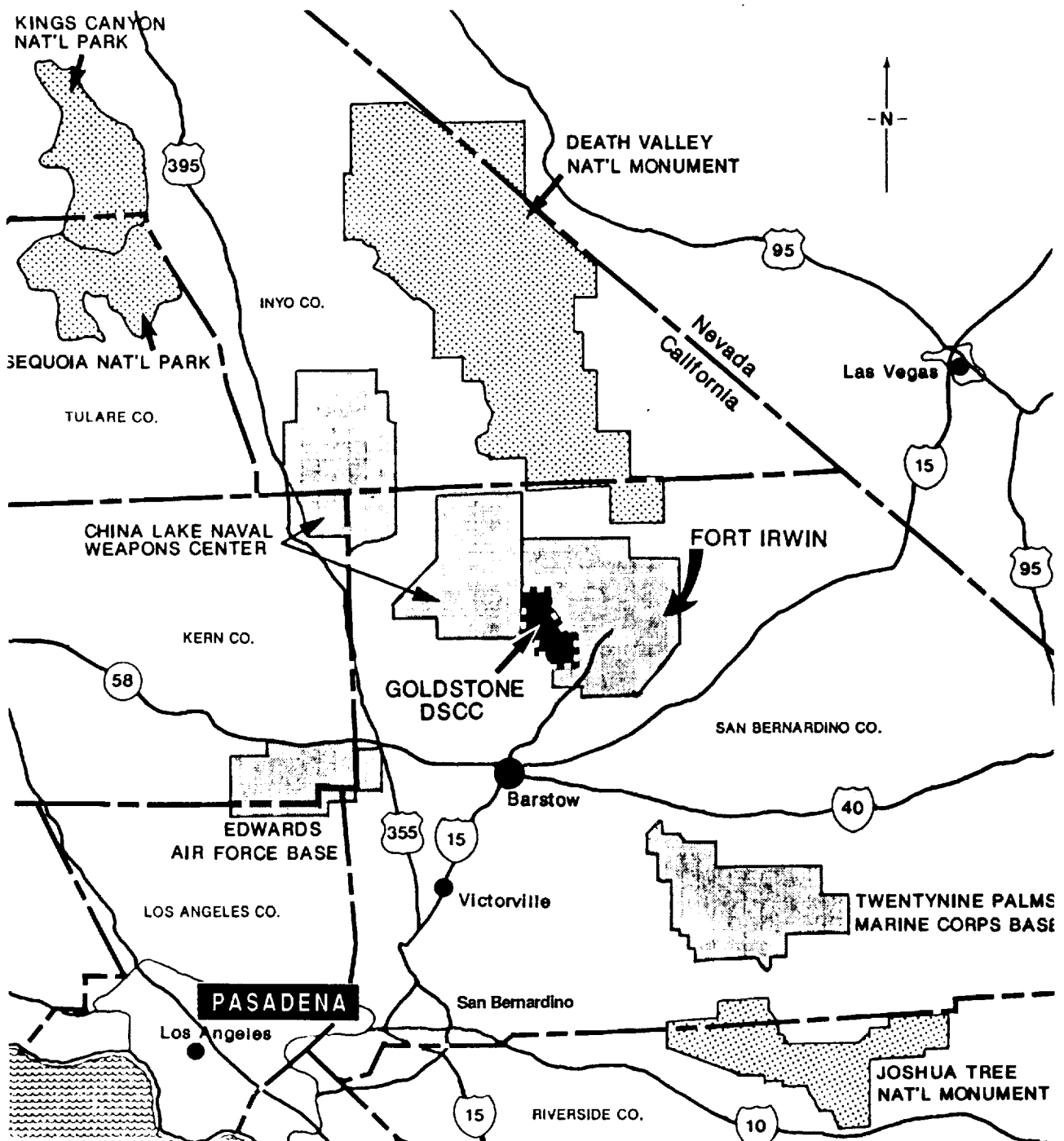


Figure 1. Geographic Relationship of the Goldstone Deep Space Communications Complex to JPL in Pasadena

Goldstone also is a research and development center to extend the communication range and to increase the data acquisition capabilities of the DSN. It serves as a proving ground for new operational techniques. Prototypes of all new equipment are thoroughly tested at Goldstone before they are duplicated for installation at overseas stations (see Section II, C below).

### C. FACILITIES AT THE GDSCC

The GDSCC is a self-sufficient, working community with its own roads, airstrip, cafeteria, electrical power, and telephone systems and is equipped to conduct all necessary maintenance, repairs, and domestic support services. Facilities at the GDSCC include about 100 buildings and structures that were constructed during a 30-year period from the 1950s through the 1980s. The construction of additional buildings and structures continues today as the GDSCC increases its activities and operations.

Goldstone is one of three Deep Space Communications Complexes (DSCCs) operated by NASA that are located on three continents: at Goldstone in Southern California's Mojave Desert; in Spain, about 60 kilometers (37 miles) west of Madrid at Robledo de Chavela; and near the Tidbinbilla Nature Reserve, in Australia, about 40 kilometers (25 miles) southwest of Canberra. Because these three DSCCs are approximately 120 degrees apart in longitude, a spacecraft always is in view of one of the DSCCs as the Earth rotates on its axis (Figure 2).

Activities at the GDSCC operate in support of seven parabolic dish antennas, at five sites called Deep Space Stations (DSSs): four DSSs are operational, one is devoted to research and development (R&D) activities, and one has been deactivated. There also are four, similar, operational DSSs in Spain and in Australia. Thus, the NASA DSN consists of a worldwide network of 12 operational DSSs. In addition, an eighth parabolic dish antenna at Goldstone is operated by the National Oceanic and Atmospheric Administration (NOAA).

A Network Operations Control Center (NOCC), located at JPL in Pasadena, controls and monitors the DSN. A Ground Communications Facility (GCF) of the DSN operates to link together the NOCC at JPL with the three DSCCs at Goldstone, Spain, and Australia.

Total NASA/JPL facilities at the GDSCC (Figure 3) include the seven parabolic dish antennas, an airport, a microwave test facility, miscellaneous support buildings, and a remote support facility in Barstow located about 45 miles southeast of the GDSCC. The GDSCC support staff consists of about 260 personnel on site and at the Barstow facility. Table 1 summarizes the major facilities, buildings (number and square footage), and antennas (construction date and size). Three sites within the GDSCC have antennas (referred to as stations) devoted to NASA operations (Echo Site, Mars Site (two antennas), and Apollo Site). Two other sites have antennas devoted to research and development: (Venus, operated by the GDSCC, and Mojave, operated by the National Oceanic and Atmospheric Administration). A 26-meter (85 foot) antenna, located at the Pioneer Site, was deactivated in 1981. In 1985, the Pioneer antenna was designated a National Historic Landmark by the U.S. Department of Interior and the Pioneer Site was returned to the U.S. Army. Each of the Goldstone sites is briefly described below.

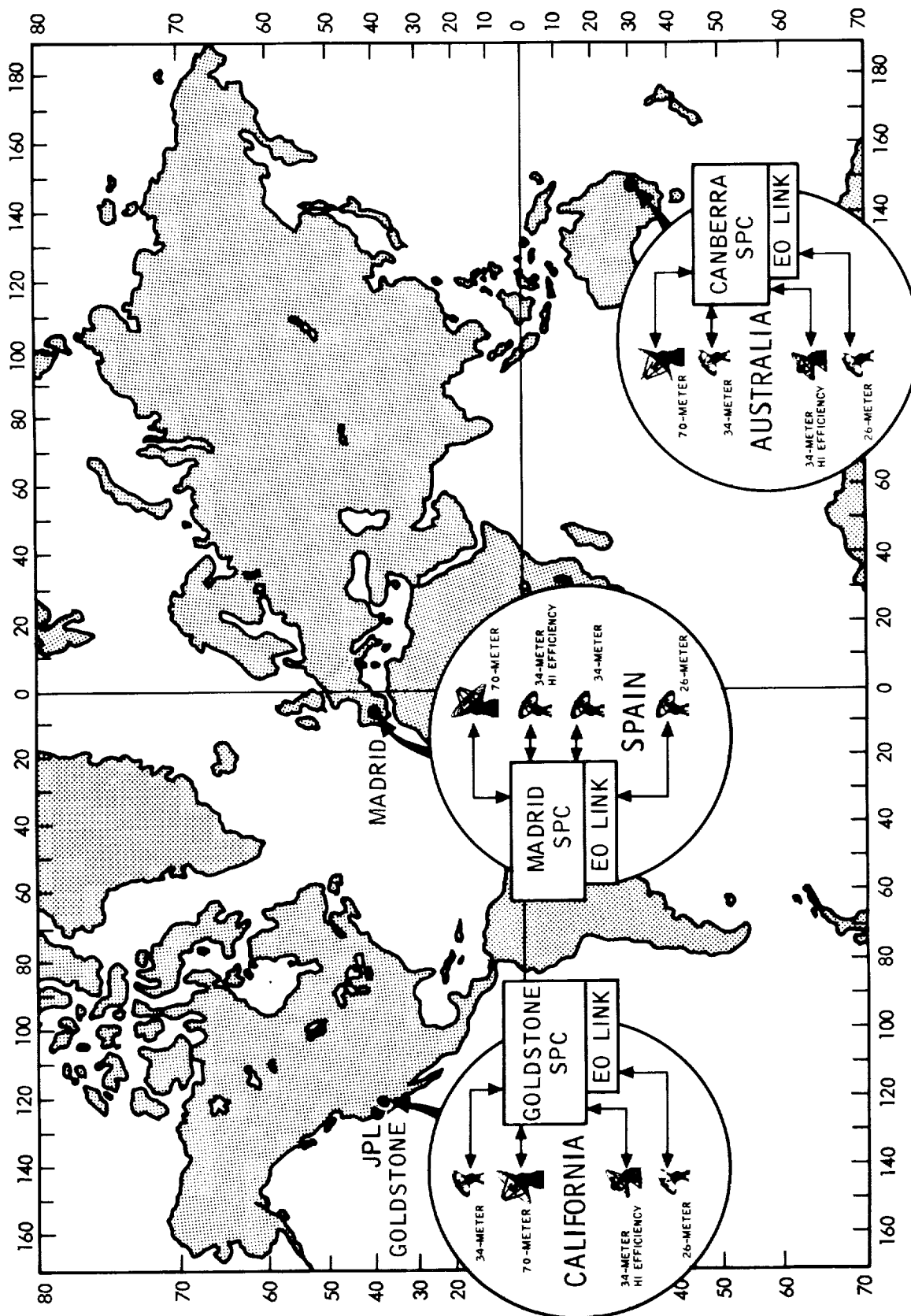


Figure 2. The Three-Continent NASA Deep Space Network as it Exists in 1989



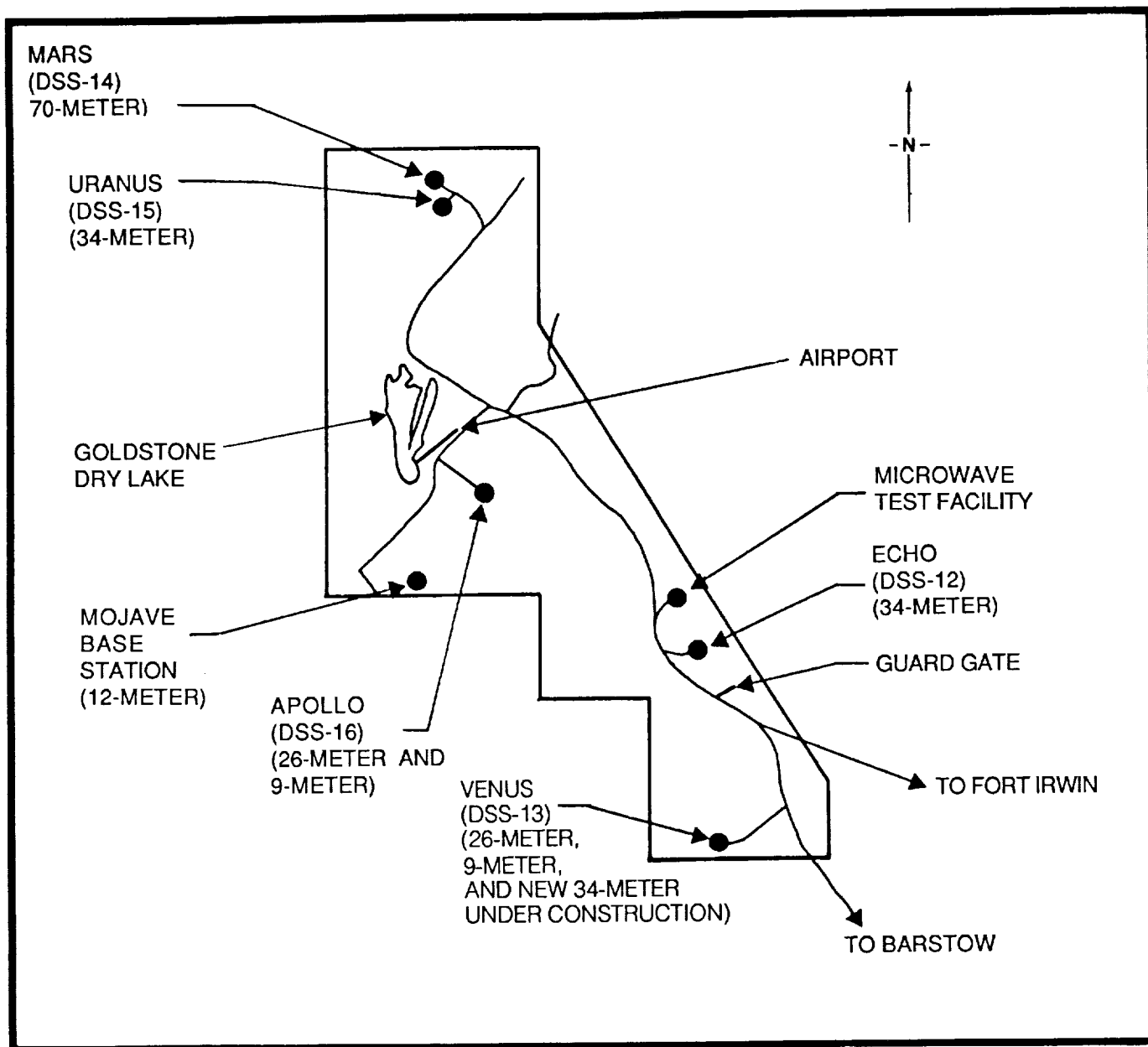


Figure 3. Schematic Map of the Goldstone DSCC Showing Locations of the Five NASA Deep Space Stations (DSSs) and the Mojave Base Station Operated by NOAA

Table 1. Major Facilities at the GDSCC

Site	Station Number	Buildings		Antennas	
		Number	SF (ft <sup>2</sup> )	Date of Construction	Size (Meters)
Echo Site	DSS-12	24	86,662	1961 <sup>a</sup>	34
Venus Site	DSS-13	12	12,502	1962 <sup>b</sup>	26 9
Mars Site	DSS-14	11	36,834	1966	70 <sup>c</sup>
	DSS-15			1984	34
Apollo Site	DSS-16	23	43,985	1965 <sup>d</sup>	26 9
Mojave Site		5	11,850	1964	12 <sup>e</sup>
Airport <sup>f</sup>		2	710	1963/1970	--
Microwave Test Facility	MTF	1	2,880	1963	--
Miscellaneous	--	3	1,430	--	--
Barstow Facility <sup>g</sup>		1	28,343	--	--

<sup>a</sup>Original antenna, built in 1959, was moved to Venus Site in 1962. A new 26-meter antenna, built in 1961, was extended to 34 meters in 1978.

<sup>b</sup>Antenna was constructed at Echo Site in 1959 and moved to the Venus Site in 1962.

<sup>c</sup>Originally constructed as a 64-meter antenna in 1966. Enlarged to a 70-meter antenna in 1988.

<sup>d</sup>Antenna originally was constructed for the NASA Goddard Space Tracking and Data Network. JPL/GDSCC/DSN operation of the antenna began in October 1984.

<sup>e</sup>This antenna is operated by the National Oceanic and Atmospheric Administration (NOAA).

<sup>f</sup>The airport is located at the Goldstone Dry Lake.

<sup>g</sup>This site, a leased facility, is located in Barstow, California about 45 miles southwest of the GDSCC.

Source: Directory of Goldstone DSCC Buildings and Supporting Facilities (Gold Book, Document 890-165, JPL internal document), Jet Propulsion Laboratory and National Aeronautics and Space Administration, December 1, 1985.

#### D. ANTENNA STATIONS AT THE GDSCC

##### 1. Echo Site (DSS-12)

The Echo Site, as the administration center and operations headquarters of the GDSCC, is the most extensively developed site on the complex. It has one 34-meter (111.5 ft) antenna and 24 support buildings having a combined area of 86,622 ft<sup>2</sup> (SF). Support buildings include administration and engineering offices, cafeteria and dormitory facilities, transportation and maintenance facilities, storage areas, and warehouses. Echo Station originally was built in 1959 as a 26-meter (85 foot) antenna. The antenna was first used in 1960 in support of the Echo Project, an experiment to transmit voice communications coast-to-coast by bouncing radio signals off the reflective Mylar surface of a passive balloon-type satellite. In 1962, this original 26-meter antenna was moved to the Venus Site. In anticipation of this move, a newer 26-meter antenna had been built at the Echo Site in 1961. In 1978, this antenna was enlarged to 34 meters (111.5 ft). The present antenna is approximately 35 meters (113 feet) high and weighs about 270,000 kilograms (300 tons).

##### 2. Venus Site (DSS-13)

The Venus Site consists of two antennas: a 26-meter (85 ft) antenna, and a 9-meter (29.5 ft) antenna. The smaller antenna is no longer used. There are 11 buildings having a combined area of 12,502 SF. The support buildings provide space for operations control, laboratories, offices, security, workshops, warehouses, and mechanical equipment. The 26-meter antenna, which was originally located at Echo Site, was moved to the Venus Site in 1962. The antenna was used for a radar astronomy study of the planet Venus. Currently, its primary function is research and development and performance and reliability testing of high power radio-frequency transmitters and new systems and equipment prior to their introduction into the Deep Space Network. A new 34-meter (111.5 ft) antenna is now under construction to replace the 26-meter antenna. The new antenna is planned to begin research and development activities in 1991. An Environmental Assessment concerning this new antenna is the subject of JPL Publication 87-4, Volume 6, Environmental Assssment: New 34-Meter Antenna at Venus Site (June 15, 1988).

##### 3. Mars Site (DSS-14 and DSS-15)

The Mars Site consists of two antennas and 13 buildings with a combined area of 36,834 SF. The support buildings provide facilities for operations control, offices, training, mechanical equipment, storage, and security. In May 1989, M.B. Gilbert Associates (MBCA), Long Beach, California, submitted to JPL an Environmental Assessment concerning the construction work needed for a proposed addition to the Operations Building (Bldg. G-86) at the Mars Site. This environmental assessment will be the subject of a future JPL report in this continuing series of Environmental Projects reports about the GDSCC.

The Mars Station Antenna (DSS-14), at 70-meters (210 ft) in diameter, is one of the larger antennas of its kind in the world (see Front Cover). The antenna, which was constructed as a 64-meter antenna in 1966 and enlarged to

70-meters in 1988, is 6.5 times more powerful and sensitive than a 26-meter antenna, extending the range of deep space communications by 2.7 times. It can maintain communications with spacecraft even to the edge of the solar system. Standing more than 235 ft high, this antenna is one of the more striking features to be seen in the GDSCC geographic area. The 70-meter antenna was used in August 1989 for the Voyager 2 spacecraft's encounter with the planet Neptune, which is located at a distance from Earth of 4.5 billion kilometers (2.8 billion miles).

The Uranus Station Antenna (DSS-15) is a 34-meter, high efficiency (HEF), precision-shaped antenna, located approximately 1,600 ft southeast of the Mars Station Antenna. Built in 1984, this latest antenna-addition at the GDSCC first was used in January 1986 to support the encounter of the Voyager 2 spacecraft with the planet Uranus, which is located at a distance of more than 3 billion kilometers (1.8 billion miles) from Earth. The new, proposed 34-meter antenna now under construction at the Venus Site (see above) is similar in size and structure to this Uranus antenna.

#### 4. Apollo Site (DSS-16)

The Apollo Site has a 26-meter (85-ft) antenna, a 9-meter (29.5 ft) antenna, and 18 buildings having a combined area of 43,985 SF. The buildings provide space for operations, equipment, storage, and warehousing. The 26-meter antenna originally was constructed in 1965 by the NASA Goddard Space Tracking and Data Network to support the manned Apollo missions to the moon. Operation of this antenna under the JPL/GDSCC/DSN began in October 1984. Both the 26-meter and the 9-meter antennas now are used to support the missions of the Space Shuttle (STS) and satellites in both low- and high-Earth orbits. In May 1989, M.B. Gilbert Associates, Long Beach, California, submitted to JPL an Environmental Assessment concerning the construction work needed for a proposed new 34-meter antenna at the Apollo Site. This environmental assessment will be the subject of a future JPL report in this continuing series of Environmental Projects reports about the GDSCC.

#### 5. Mojave Base Site (NOAA Antenna)

The Mojave Base Site has five buildings with a combined area of 11,850 SF. At one time, these buildings provided support facilities for operations, equipment, and maintenance. Except for the NOAA operations buildings, however, these buildings now are not in use.

The Mojave Base Station Antenna is a 12-meter (40-ft) antenna operated by NOAA. The antenna is involved in several programs including monitoring of shifts in the Earth's plates, monitoring weather changes, and retrieving information from very low-orbiting Earth satellites.

### E. SUPPORT FACILITIES AT THE GDSCC

#### 1. Goldstone Dry Lake Airport

The airport consists of an approximately 6,000 ft by 100 ft paved runway. There are two buildings at the airport site, both of which are

presently not in use. An open hangar is used to provide shelter for a single aircraft. For its personnel, NASA operates three scheduled shuttle flights per week to the GDSCC that originate from the Burbank-Glendale-Pasadena Airport. In addition, the Goldstone airport is used infrequently by administrative Army flights. Both NASA and the U.S. Army use propeller-driven aircraft.

## 2. Microwave Test Facility and Fire Training Area

The Microwave Test Facility (MTF) and Fire-Training Area consists of a single building of 2,880 SF along with areas identified for fire fighting. The MTF is used for research and development testing of antenna equipment. Fire training includes procedures for the quenching of fires.

## 3. Miscellaneous Buildings in the GDSCC Area

Three buildings and structures at the GDSCC that fall into this category include the main gatehouse, pump house, and radio spectrum monitor. Total area of these three buildings/structures is 1,430 SF.

## 4. Off-Site Facility at Barstow, California

In addition to the above-mentioned on-site facilities, the GDSCC leases an office and warehouse support facility in the nearby city of Barstow. The facility is a single story, 28,343 SF structure located at 850 Main Street.

# F. NON-STRUCTURAL SUPPORT FACILITIES AT THE GDSCC

## 1. Transportation Network

The major roadways in the area are shown in Figure 4. The only surface public transportation route to the GDSCC is by the Fort Irwin Road that leads to Fort Irwin. The NASA Road cutoff from Fort Irwin Road leads into the GDSCC. NASA Road merges with Goldstone Road, which is the only north-south paved access road within the complex. Both NASA and Goldstone Roads are paved two-lane roads and are maintained by the Ft. Irwin Post Engineer. Two-lane paved access roads also lead to each of the sites and major facilities.

## 2. Utilities and Services

The Southern California Edison Company provides electricity for the Goldstone Complex. The GDSCC provides its own backup diesel-engine generators for operations during emergencies and to ensure continuity of electrical service for prescheduled periods of time. Gasoline, diesel oil, and hydraulic oil are stored in underground storage tanks. Water is supplied by Fort Irwin from groundwater basin wells. Sanitary sewage is discharged through septic tank systems to leaching fields. The Echo and Mars Sites discharge wastewater to evaporation ponds.

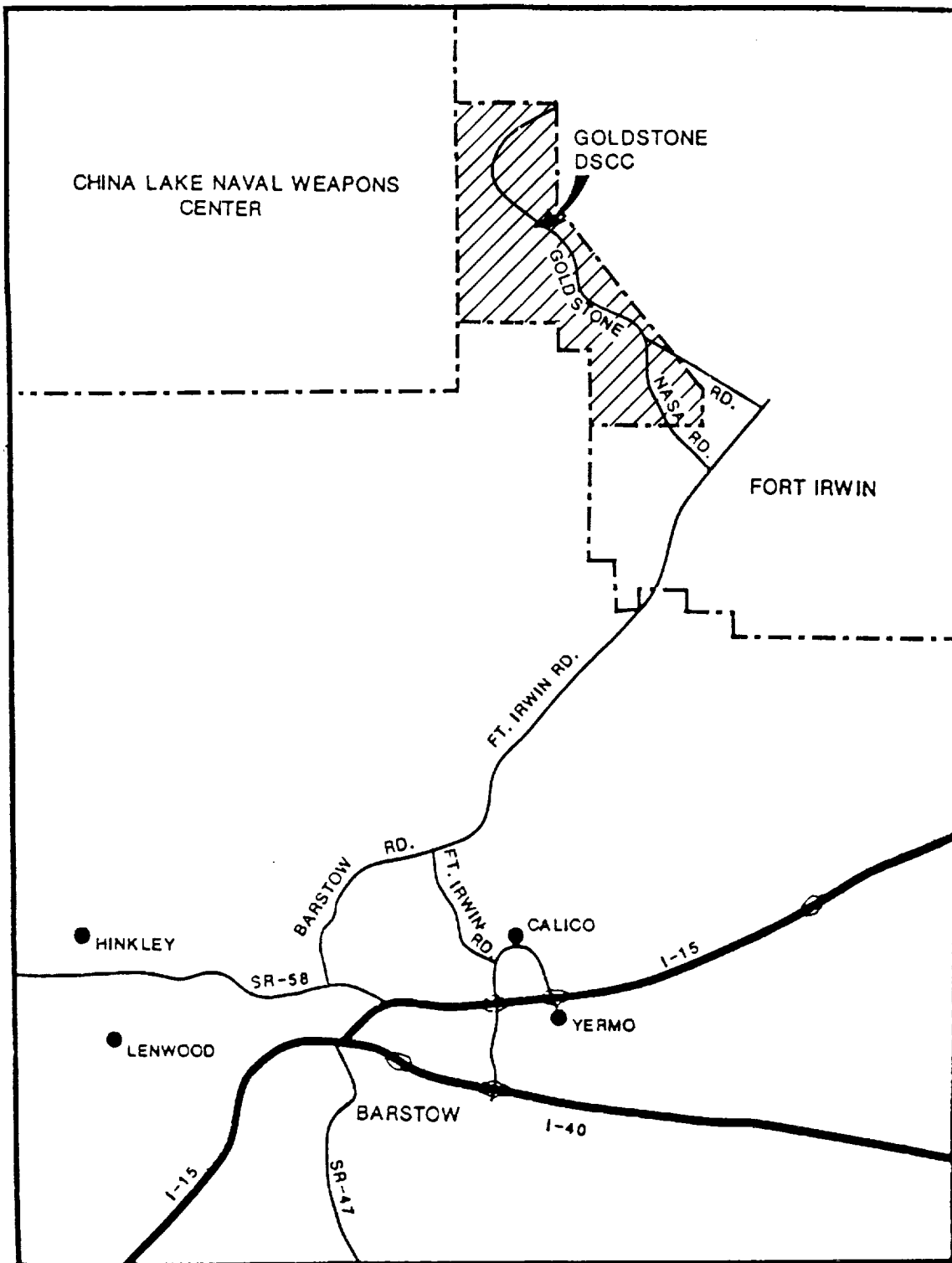


Figure 4. Major Roads Leading to and at the Goldstone DSCC

#### G. SOLID-WASTE MANAGEMENT FACILITIES AT THE GDSCC

At the Echo Site, the GDSCC operates its own 6-acre, Class III solid-waste landfill. This facility accepts only non-hazardous, solid wastes.

Most of a small quantity of hazardous waste, generated at the GDSCC each year, is sent to off-site commercial facilities for reclamation and eventual reuse. The remainder is transported to off-site commercial treatment or disposal facilities within 90 days of generation. The GDSCC now has two, new, properly managed storage facilities for hazardous materials and wastes, one at Echo Site and the other at Venus Site, but operates no facilities requiring a hazardous waste permit. Details concerning the construction of these two new storage facilities for hazardous materials and wastes at the Echo and Venus Sites will be presented in Volume 9 of this continuing series of reports dealing with Environmental Projects at the GDSCC. Two more storage facilities for hazardous materials and wastes, one at Mars Site and the other at Apollo Site, are to be completed early in 1990. In accordance with its environmental management program, the GDSCC conducts all of its waste-management operations in strict compliance with environmental regulations, in a manner consistent with protection of human health and the environment.

#### H. WASTEWATER MANAGEMENT FACILITIES AT THE GDSCC

Four functioning wastewater evaporation ponds - one pair at the Echo Site and another pair at the Mars Site - are designed to receive effluent from upstream septic tank systems. Extensive work was completed in the spring of 1989 to repair and reform the previously eroded embankments of the evaporation ponds.

#### I. OPERATIONAL RELATIONSHIPS BETWEEN THE GDSCC AND FORT IRWIN

Because the GDSCC is located within the Fort Irwin property, the two installations potentially can affect each other's roles and missions. Fort Irwin is a U.S. Army installation serving as the U.S. Army National Training Center (NTC). The remote desert environment allows military task forces to practice large-scale training maneuvers that could affect natural, historic, and cultural resources at the GDSCC. This especially is true when the maneuvers involve the movement of heavy equipment (tanks, large trucks) within the GDSCC. Most maneuvers occur at the eastern border of the GDSCC and every effort is made by both the GDSCC and Ft. Irwin personnel to avoid the use of sensitive areas for such maneuvers.

#### J. NATURAL ENVIRONMENTAL ASPECTS OF THE GDSCC

##### 1. Geology

The GDSCC is located in a naturally-occurring bowl-shaped depression bounded on three sides by geological faults. The Garlock Fault lies to the north, while the Blackwater and Calico Faults lie, respectively, to the west and south. The GDSCC is bounded on the east by the Tiefort Mountains. Each antenna site at the GDSCC is located on natural alluvial material, ranging in thickness from 15 feet at the Venus Site to more than 70 feet at the Echo Site. The alluvium is derived from the surrounding hills.

## 2. Hydrology

Groundwater in the Goldstone area is generally confined and is found at depths ranging from 170 ft near the Minitrack Site to approximately 1,000 ft below the Echo Site. Chemical analyses of the groundwater have yielded total dissolved solids (TDS) values in excess of 1,000 ppm indicating the groundwater is brackish. The Goldstone Complex currently obtains potable water from a group of wells located at Fort Irwin, approximately ten miles to the southeast.

## 3. Climatic Conditions

The GDSCC lies within the U.S. Naval Weather Service's Southwest Desert, Climatic Area A. Mean annual temperatures for the area range from 50° to 80°F. Temperatures can climb as high as 114°F during the summer months, and drop as low as 11°F during the winter months. Mean annual precipitation for the area is approximately 2.5 inches with most precipitation falling between November and February.



## SECTION III

### WASTEWATER EVAPORATION PONDS AT THE GDSCC

#### A. HISTORY OF THE WASTEWATER EVAPORATION PONDS

On December 3, 1958, JPL became a part of NASA. Earlier that year, however, a JPL survey team, under contract to the U.S. Army to develop a site for a ground communications and navigation network for the soon-to-be launched Pioneers 3 and 4 spacecraft, had visited the Mojave Desert area and had selected a bowl-shaped terrain near Goldstone Dry Lake on the U.S. Army's Fort Irwin military reservation northwest of the desert city of Barstow. Work to prepare the site proceeded during the spring, summer, and autumn of 1958. On December 6, 1958, only three days after JPL had been transferred to NASA, the newly completed Pioneer antenna began operation with the launch of Pioneer 3 on a trajectory toward the Moon. This was the beginning of the operation of the GDSCC.

One of the more immediate and mundane problems faced by the thriving and growing fledgling GDSCC was the treatment and disposal of sewage wastewater. To solve this problem, wastewater evaporation ponds, designed to receive and evaporate the effluent from upstream septic tank systems, were constructed in the late 1950s and early 1960s.

Two wastewater evaporation ponds placed back-to-back were constructed at the Echo Site and two similarly positioned wastewater evaporation ponds were constructed at the Mars Site. These four functioning wastewater evaporation ponds were constructed by excavation of the native desert soil and piling the removed soil around the excavation to form embankments that vary from 2 to 6 ft above the overall grade elevation of the excavation site. The interior slopes of the embankments then were lined with a two-foot layer of clay material obtained on-site within the GDSCC. The clay material acted as a water-impermeable liner to prevent the seepage of the contained wastewater into the surrounding soil. Over the years, however, various processes contributed to severe degradation and erosion of the original clay liners.

Thus, in May 1989, work was completed to renovate and reshape the Echo and Mars wastewater evaporation ponds and to reline and fit the inner slopes of the embankments with a concrete-filled, water-impervious, erosion-control mattress.

The contrast between the eroded and degraded original wastewater evaporation ponds and the newly renovated and relined wastewater evaporation ponds can be seen in the "before and after" photographs represented by Figures 5 and 6, respectively.

A fifth wastewater evaporation pond, and its associated above-ground sewage treatment plant, was constructed about 1980 at the Mojave Base Station. At that time, the Mojave Base Station was operated by NASA's Goddard Space Tracking and Data Network. After a brief operational testing period, the sewage treatment plant and wastewater evaporation pond were abandoned. It is planned to demolish and remove the sewage treatment plant and to close and grade the wastewater evaporation pond area in an environmentally suitable and correct manner.



Figure 5. Typical View of a Degraded and Eroded Wastewater Evaporation Pond Before the Pond was Renovated and Relined



Figure 6. Typical View of a Wastewater Evaporation Pond (Echo Site) after Pond was Renovated and Relined with Concrete-Filled, Erosion-Control Mattress

Location of the on-site wastewater evaporation ponds at Echo Site (two functioning ponds), Mars Site (two functioning ponds) and at Mojave Base Site (one unused and abandoned pond) are shown in Figure 7.

#### B. OPERATION OF THE WASTEWATER EVAPORATION PONDS

Wastewater evaporation ponds at the GDSCC are part of a wastewater treatment system that also involves septic tanks and leach lines.

The septic tanks at the GDSCC are standard, multi-compartment, concrete basins. Access to the tanks is through 24-in. diameter manholes. All wastes discharged to the septic tanks are domestic-type wastewaters. No industrial wastewaters containing hazardous constituents are discharged into the septic tanks.

The wastewater evaporation ponds at the GDSCC are designed to receive and evaporate the wastewater effluent from the septic tank systems that are located upstream of the ponds. The normal mode of wastewater flow at the Echo and Mars Sites at the GDSCC is as follows:

- (1) All wastewaters flow from the site buildings through pipelines to the septic tanks.
- (2) Effluent from the septic tanks is split into two flows. An extremely minor portion of the effluent is directed to leach lines to provide sufficient moisture for the soil to function as an electrical grounding field. The major part of the effluent, however, is discharged to the wastewater evaporation ponds.
- (3) The four functioning wastewater evaporation ponds at the GDSCC are constructed as two, back-to-back pairs. One pair is at Echo Site, while the other is at Mars Site. For about a year, all flows from the septic tanks to the wastewater evaporation ponds are directed exclusively to only one of the pair of ponds. At the end of this period, flows then are redirected exclusively to the other pond of the pair. The first pond, now no longer receiving any inflow from the septic tanks, is allowed to evaporate to dryness. This cycle repeats itself after each year of operation.
- (4) As necessary, septic tanks are pumped by an outside contractor, and the waste is transported out of the GDSCC to an approved, licensed landfill for disposal.

#### C. EROSION OF THE WASTEWATER EVAPORATION PONDS

The wastewater treatment systems at the Echo and Mars Sites at the GDSCC, described above, have functioned very well since they first were constructed about 30 years ago. Over the years, however, the clay surfaces that line the inner embankments of the wastewater evaporation ponds and serve as water-impervious barriers to the outflow of effluent from the ponds have become seriously degraded and eroded through the actions of strong winds, precipitation, waves lapping at the embankments, burrowings by rodents, and root penetration by the growth of diverse weeds.

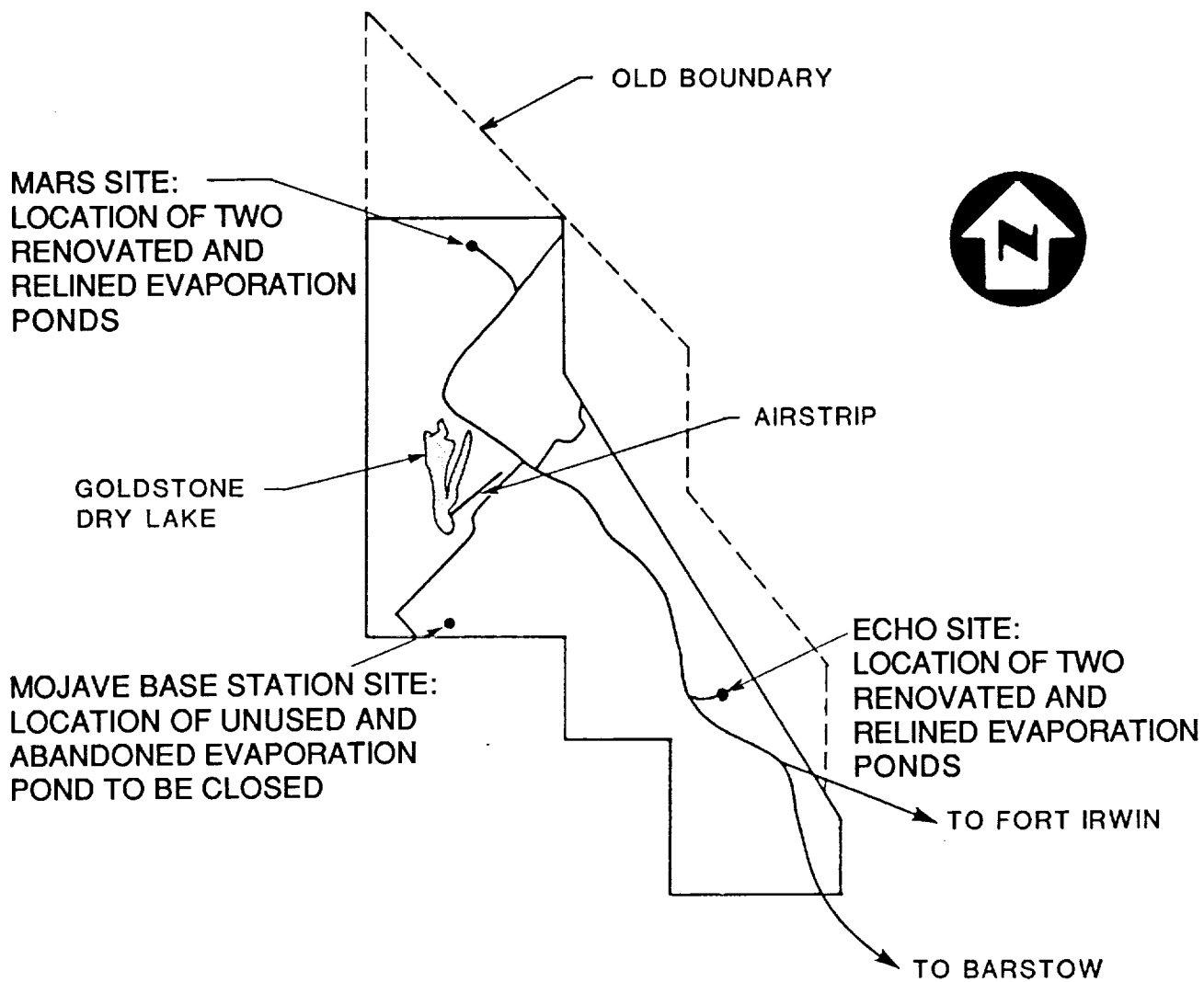


Figure 7. Schematic Map of the GDSCC Showing On-Site Locations of the Five Wastewater Evaporation Ponds

Figures 8, 9, 10, 11 and 12 depict typical erosion, fissuring, and crevice-formation of embankments of the originally clay-lined wastewater evaporation ponds.

Thus, the pond-embankments no longer functioned as water-impervious barriers to constrain the effluent wastewater within the wastewater evaporation pond. Were this situation allowed to continue, and not remedied, the damage to the existing clay-surface pond-linings would progress and sewage effluent eventually could seep into the unprotected soil surrounding the wastewater evaporation ponds. Over an extended period of time, the embankments could erode enough to allow the septic tank effluent to escape from the pond not only by seepage, but also by flowing directly through breaches in the failed embankments.

Such a situation is environmentally untenable and is prohibited by County and State ordinances. To prevent its occurrence, NASA/JPL decided to renovate and reline the four functioning wastewater evaporation ponds at the GDSCC.

#### D. RENOVATION AND RELINING OF THE WASTEWATER EVAPORATION PONDS AT THE GDSCC

##### 1. Preparation of a Preliminary Engineering Report

After JPL decided to renovate and reline the four functioning wastewater evaporation ponds at the GDSCC, it retained Engineering-Science (E-S), Inc., Pasadena, California, to prepare a Preliminary Engineering Report dealing with the problem of how best to repair the eroded embankments of the wastewater evaporation ponds. Detailed aspects of the E-S Preliminary Engineering Report, submitted by E-S to JPL in December 1987, are described in Environmental Projects: Volume 5, Part One: Subsurface Contamination Study, JPL Publication 87-4, April 15 1988.

The E-S report considered six alternatives for the repair and relining of the embankments of the wastewater evaporation ponds: reline the eroded clay lining with another lining of the same locally found clay material; reline with high density plastic sheets; reline with a mixture of bentonite and soil; reline with soil cement; reline with granite; and reline with a fabric-formed concrete layer.

Consideration of these six alternative linings led to the selection of the fabric-formed concrete layer as the lining of choice because of its reasonable cost and long useful life.

##### 2. Environmental Assessment of the Work Required to Modify the Wastewater Evaporation Ponds

Before work could begin to modify the four functional wastewater evaporation ponds at the Echo and Mars Sites of the GDSCC, an environmental assessment had to be carried out and written up in a report. Engineering Science Inc., Pasadena, California, was retained by JPL to carry out the assessment and write the report. In April 1988, E-S submitted the Environmental Assessment to JPL. It documented the existing conditions, analyzed the environmental effects, and presented mitigation measures for the work to be done to modify the four functional wastewater evaporation ponds at the GDSCC.



Figure 8. Typical Erosion of an Embankment of a Wastewater Evaporation Pond

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Figure 9. Typical Vertical Erosion of an Embankment of a Wastewater Evaporation Pond



Figure 10. Typical Erosive Fissuring of an Embankment of a Wastewater Evaporation Pond



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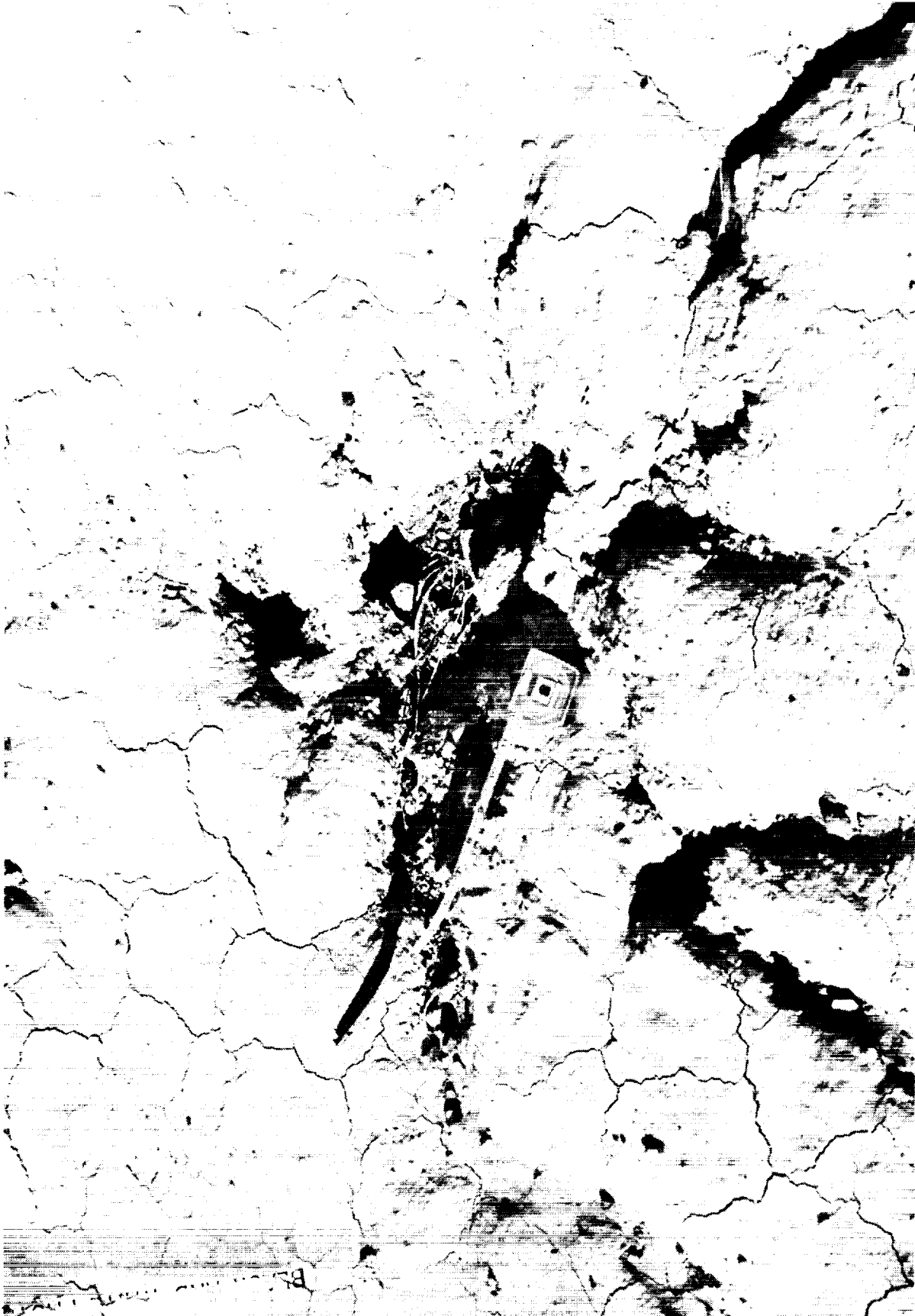


Figure 11. Fissures and Crevices in Eroded Embankment of a Wastewater Evaporation Pond



Figure 12. Broad View of Embankment Erosion of a Wastewater Evaporation Pond

The Environmental Assessment concluded that the proposed actions to repair the embankments of the wastewater evaporation ponds would have no significant adverse impacts upon the GDSCC environment. Thus, in accordance with the National Environmental Policy Act (NEPA), the implementing regulations of the Council on Environmental Quality, and the implementation provisions of NASA, the proposed project to repair the eroded embankments of the wastewater evaporation ponds at the GDSCC was eligible for a Finding of No Significant Impact (FONSI).

As part of its Environmental Assessment, E-S considered the effects, if any, that the work to modify the wastewater evaporation ponds would have on the natural environment of the GDSCC. None of the effects were significant.

NASA considers the following 13 items to be specific environmental resources that must be considered in an environmental assessment:

- (1) Air resources
- (2) Water resources
- (3) Land resources
- (4) Biotic resources
- (5) Endangered species
- (6) Wetlands and floodplains
- (7) Solid waste generation, treatment, storage and disposal of toxic substances
- (8) Toxic substances
- (9) Pesticides
- (10) Radioactive materials and nonionizing radiation
- (11) Noise
- (12) Historical, archeological and cultural factors
- (13) Economic, population and employment factors (NASA, 1980).

These environmental factors, with particular reference to the GDSCC, are described in detail in Section III of Environmental Resources Document, Environmental Projects: Volume 7, JPL Publication 87-4, September 15, 1988.

### 3. Design of the Modifications of the Wastewater Evaporation Ponds

Following its submission of the Preliminary Engineering Report and Environmental Assessment, E-S submitted the Engineering Design Drawings, including calculations and specifications, that describe in detail the work that was necessary to repair the eroded embankments of the wastewater evaporation ponds.

#### 4. Description of the Fabric-formed Concrete Layer Selected as the Lining Material for the Wastewater Evaporation Ponds

The material selected to be the liner of the renovated ponds is a water-impervious, cast-in-place concrete, erosion-control mattress that is easily installed both above and below water. The basic mattress is formed from a woven panel of a double-layered, water-permeable, synthetic fabric. The panels are joined together to form a continuous fabric mold that then can be filled with concrete to form the erosion control mattress.

The fabric panels first are positioned over the reshaped and trenched embankments of the pond (Figure 13). The panels then are filled with a pumpable, fine-aggregate, concrete slurry. As the fabric fills up with the concrete, it assumes a waffle-shaped pattern (Figure 14). The water-permeable fabric prevents the loss of the concrete while allowing the mixing water of the slurry to escape. The result is a low water/cement ratio that leads to accelerated hardening and a durable concrete structure (Figure 15). The thickness of the mattress is controlled by interior spacer cords in the fabric panels. When the fabric is filled with concrete, the spacer cords straighten out to their full length to form a concrete lining of uniform minimal thickness.

#### 5. Work Carried Out to Renovate and Reline the Wastewater Evaporation Ponds at the GDSCC

After the submittal of the E-S Environmental Assessment in April 1988, and its acceptance, E-S began the engineering design to implement the renovation and relining of the four functional wastewater evaporation ponds at the GDSCC. Another contract also was signed with Engineering-Science, Inc., Pasadena, California, to oversee the construction aspects of the project, while Jenkin Construction Company, Long Beach, California, was selected to be the Contractor to carry out the actual construction.

Work on the wastewater evaporation ponds began in December 1988 and was completed in May 1989. A chronology of the progress of the work on the two wastewater evaporation ponds at Echo Site is presented in Table 2, while a similar chronology for work on the two wastewater evaporation ponds at Mars Site is given in Table 3. A summary chronology of the milestones of the project is presented in Table 4.

Before the work began, the extent of a typical-eroded embankment of a wastewater evaporation pond is shown in Figure 16. The first step in the renovation process was the drainage of the pond to expose the pond bottom and let it dry (Figures 17 and 18). With the pond bottom dry, earth-moving machines then scraped and shaped the pond's bottom and embankments, and dug trenches on the inside and outside of the embankments into which the synthetic fabric for the concrete liner would fit (Figures 19, 20, and 21). Occasionally, an earth-moving machine would get mired in the muddy pond bottom and work would halt temporarily until the machine could be extricated (Figure 22).

One of the ways the newly renovated wastewater evaporation ponds differ from the original ponds is the presence of a concrete maintenance/service ramp situated halfway along an embankment with the longest dimension. This ramp will allow vehicles to descend to the pond's bottom, if this is necessary in the future, without driving over and disturbing the newly placed, concrete-filled, erosion-control mattress. While earthwork was in progress, the forms and reinforcement bars for the maintenance ramps were put in place (Figure 23). After putting in a base course material, concrete was poured to form the ramp (Figures 24 and 25). A completed, concrete, maintenance ramp is shown in Figure 26.

With earthwork completed to shape the embankments and dig trenches, the synthetic fabric that was to be filled with concrete to form the new water-impervious mattress liner was ready to be put into place. Two trenches had been dug to accommodate the ends of the fabric. One trench ran around the inner perimeter of the pond (at the points where the inner slope of the embankment meets the pond's bottom) while the other trench ran around the outer perimeter (around the top of the embankment). The synthetic fabric was installed to cover the embankment with one end dipping into the inner perimeter trench, while the other end went over the top of the embankment and was draped into the outer perimeter trench (Figures 27, 28, and 29).

After placement of the synthetic fabric liner, it is pumped full of concrete. The concrete fills up individual pockets of the double-layered fabric to yield a concrete-filled mattress liner with a waffle-shaped pattern (Figures 30, 31, 32, and 33).

When the concrete-filled, water-impervious, erosion-control mattress is completed, the bottom of the pond is given a final grading, compaction and cleaning before it receives its first inflow of wastewater (Figures 34, 35, and 36). No new clay material was added to augment the original clay liner for the pond's bottom surface. The sluice gates then are opened and wastewater flows from the full, originally eroded wastewater evaporation pond into the newly renovated empty wastewater evaporation pond (Figure 37). When the wastewater transfer is completed (Figures 38 and 39), the sluice gates are closed and the wastewater evaporation pond from which the wastewater came is allowed to dry before renovation work begins on it.

A fully renovated wastewater evaporation pond, with its concrete-filled, water-impervious, erosion-controlled mattress covering its embankments is shown in Figure 40.

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Figure 13. Synthetic Fabric Panels Fitted Over Reshaped and Trenched Pond Embankments. Fabric Liner is Ready to be Filled with Concrete.

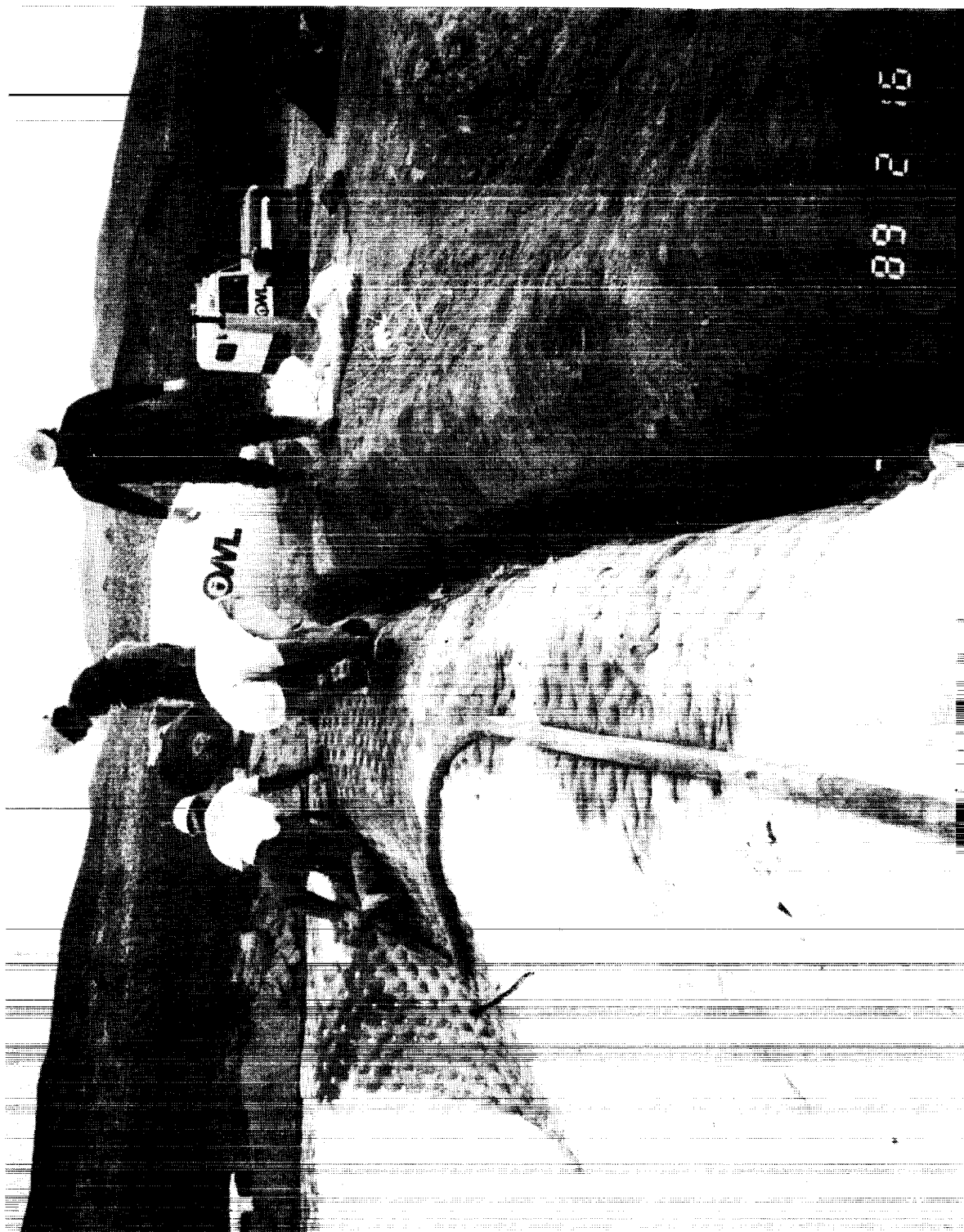


Figure 14. Filling the Fabric Panels with Concrete Slurry. Note the Waffle-Shaped Pattern of Filled Mattress Liner

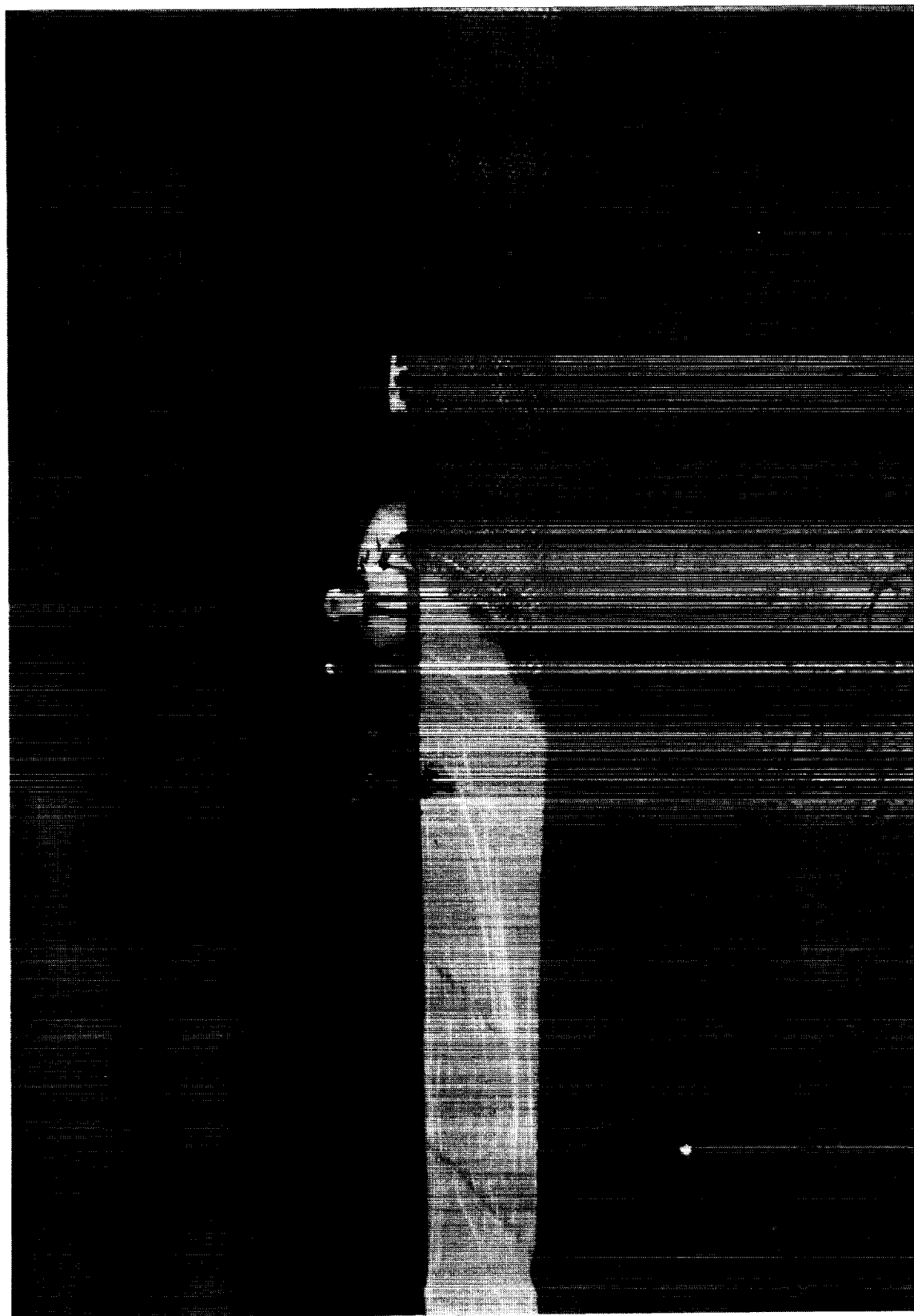


Figure 15. Progress in Filling Synthetic Fabric Liner with Concrete Slurry. Section on Left is Unfilled Fabric, While Section on Right has Assumed Waffle-Shape of the Concrete-Filled Mattress Liner

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Table 2. Echo Site: Chronology of Work Involved in Modification of Two Wastewater Evaporation Ponds.\* Ponds are Oriented North-to-South

---

1988

- 19 Dec. Earthwork began on the shaping and compaction of the slopes of the North Evaporation Pond (NEP).
- 20 Dec. Began excavation and cleaning of sump area of NEP. Disposed of removed sludge.
- 29 Dec. Grounds at the GDSCC are frozen and compaction of soils was halted until weather permitted.

1989

- 5 Jan. Grounds at the GDSCC are muddy. Difficult for earthwork or concrete-preparation work.
- 17 Jan. Began layout of forms at the NEP for the concrete maintenance ramp that is located halfway along the western embankment. The ramp slants downward from the top of the pond slope to the bottom of the pond.
- 26 Jan. Reinforcement bars were set in place for the maintenance ramp.
- 2 Feb. Poor visibility at the GDSCC. Work stopped at 11:30 am.
- 3 Feb. Strong wind gusts at the GDSCC. Work stopped at 10 am.
- 8 Feb. Rain/snow closed roads to Fort Irwin and the GDSCC. No work today.
- 14 Feb. Surface preparation of the NEP had proceeded to the point where the fabric for the liner mattress could be installed.
- 15 Feb. Concrete poured for the maintenance ramp at the NEP. Began installation of the fabric for the erosion-control mattress.
- 16 Feb. Completed installation of the erosion-control liner fabric and began pumping grout into the liner to form the erosion-control mattress.
- 23 Feb. Completed patching and repair of cracks in the concrete sluice gates that connect the NEP and the South Evaporation Pond (SEP). Completed the shaping and clean-up of the bottom of the NEP. This completed the required modifications to the NEP.

Table 2. Echo Site: Chronology of Work Involved in Modification of Two Wastewater Evaporation Ponds.\* Ponds are Oriented North-to-South (Continued)

---

1989

24 Feb.	Began the transfer of water, by pumping, from the SEP into the now completed NEP.
17 Mar.	Because of interaction with Space Shuttle operation, the GDSCC requested delays of earth-compaction until 20 March.
27 Mar.	With completion of transfer of water from the SEP to the NEP, earthwork began on the Echo SEP to shape and compact the pond's slopes. Wooden forms were prepared and placed for the concrete maintenance ramp.
30 Mar.	Rebars were set in place for the maintenance ramp.
31 Mar.	Completion of the concrete maintenance ramp.
3 Apr.	While earthwork continued, began removal and disposal of sludge from the sump area of the SEP.
11 Apr.	Earthwork was temporarily delayed as one of the grading machines became stuck in the mud of the bottom of the SEP.
18 Apr.	Earthwork resumed at the SEP.
25 Apr.	Began installation of the fabric of the erosion-control mattress at the SEP.
26 Apr.	Completed installation of the erosion-control mattress fabric and begin pumping grout into the liner to form the completed erosion-control mattress.
27 Apr.	Completed grouting of erosion-control mattress and began to backfill the trenches that had been dug to accommodate the mattress lining.
1 May	Completed grading of the area around the NEP and SEP.
4 May	Completed repair of the pond's clean-outs. This represented the completion of the work necessary to modify both of the Echo Site wastewater evaporation ponds to meet environmentally acceptable requirements.

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\*This chronology of events is based upon the Daily Field Reports written by Engineering-Science, Inc., representing JPL as the Resident Engineer.

Table 3. Mars Site: Chronology of Work Involved in Modification of the Wastewater Evaporation Ponds.\* Ponds are Oriented Northwest-To-Southwest

---

<u>1988</u>	
12 Dec.	Began to pump water out of Southeast Evaporation Pond (SEEP)
19 Dec.	Earthwork began on the shaping and compaction of the slopes of the SEEP.
27 Dec.	Began to lay out and stake out future work on the Northwest evaporation pond (NWEP).
29 Dec.	Grounds at the GDSCC are frozen and compaction of soils was halted until weather permitted.
<u>1989</u>	
5 Jan.	Grounds at the GDSCC are muddy. Difficult for earth work or concrete-preparation work.
18 Jan.	Began trenching in preparation for installation of erosion-control mattress for the SEEP. Prepared forms for concrete maintenance ramp. Ramp is located halfway along one of the long dimensions of the pond and slants downward from the tip of the pond's slope to the bottom of the pond.
25 Jan.	Reinforcement bars set in place for the maintenance ramp at the SEEP.
2 Feb.	Poor visibility at the GDSCC. Work stopped at 11:30 am.
3 Feb.	Strong wind gusts at the GDSCC. Work stopped at 10 am.
6 Feb.	Continued earthwork at the SEEP and began earthwork at the NWEP. Prepared forms for concrete maintenance ramp at the NWEP.
8 Feb.	Rain/snow closed roads to Fort Irwin and the GDSCC. No work today.
21 Feb.	Poured concrete for the maintenance ramps for both the SEEP and the NWEP. Began installation of the erosion-control mattress fabric at the SEEP.
24 Feb.	Finished pumping grout to form the erosion-control mattress at the SEEP.

Table 3. Mars Site: Chronology of Work Involved in Modification of the Wastewater Evaporation Ponds.\* Ponds are Oriented Northwest-to-Southeast (Continued)

---

<u>1989</u>	
27 Feb.	Completion of required modifications to the SEEP with final cleanup of the bottom of the pond.
6 Mar.	Continued earthwork at the NWEF and shaping of slopes and trenching to receive the fabric for the erosion-control mattress.
7 Mar.	Began effluent discharge into the newly renovated, empty SEEP.
16 Mar.	Began installation of fabric for erosion-control mattress at the NWEF.
17 Mar.	Began pumping grout into the fabric liner to form the erosion-control mattress. Because of interaction with Space Shuttle operation, the GDSCC requested delays of earth-compaction until 20 March.
21 Mar.	Completed pumping of grout to form the erosion-control mattress. Final cleanup of the bottom of the NWEF.
20 Apr.	Completed final cleanup, grading of surrounding area and dressing of the tops of the slopes of the NWEF. This represented the completion of the work necessary to modify both of the Mars Site wastewater evaporation ponds to meet environmentally acceptable requirements.

---

\*This chronology of events is based upon the Daily Field Reports written by Engineering-Science, Inc., representing JPL as the Resident Engineer.

Table 4. Summary of Milestones Met in the Planning, Design and Construction Efforts to Repair Eroded Embankments of the Wastewater Evaporation Ponds at the GDSCC

---

1987

Dec. Received Preliminary Engineering Report

1988

Jan. Engineering design work began.

Mar. Engineering design work 30 percent completed. Design reviewed.

Apr. (1) Engineering design work 60 percent completed. Design reviewed.  
(2) Received Environmental Assessment

May Funds requested for construction work.

June Engineering design work 90 percent completed. Design reviewed.

July Engineering design work completed.

Aug. San Bernardino County approves the design plans.

Oct. Period ends for submission of bids by prospective contractors.

Dec. Construction contract signed. Construction work began.

1989

May Completed the repair and renovation of the eroded embankments of the wastewater evaporation ponds.

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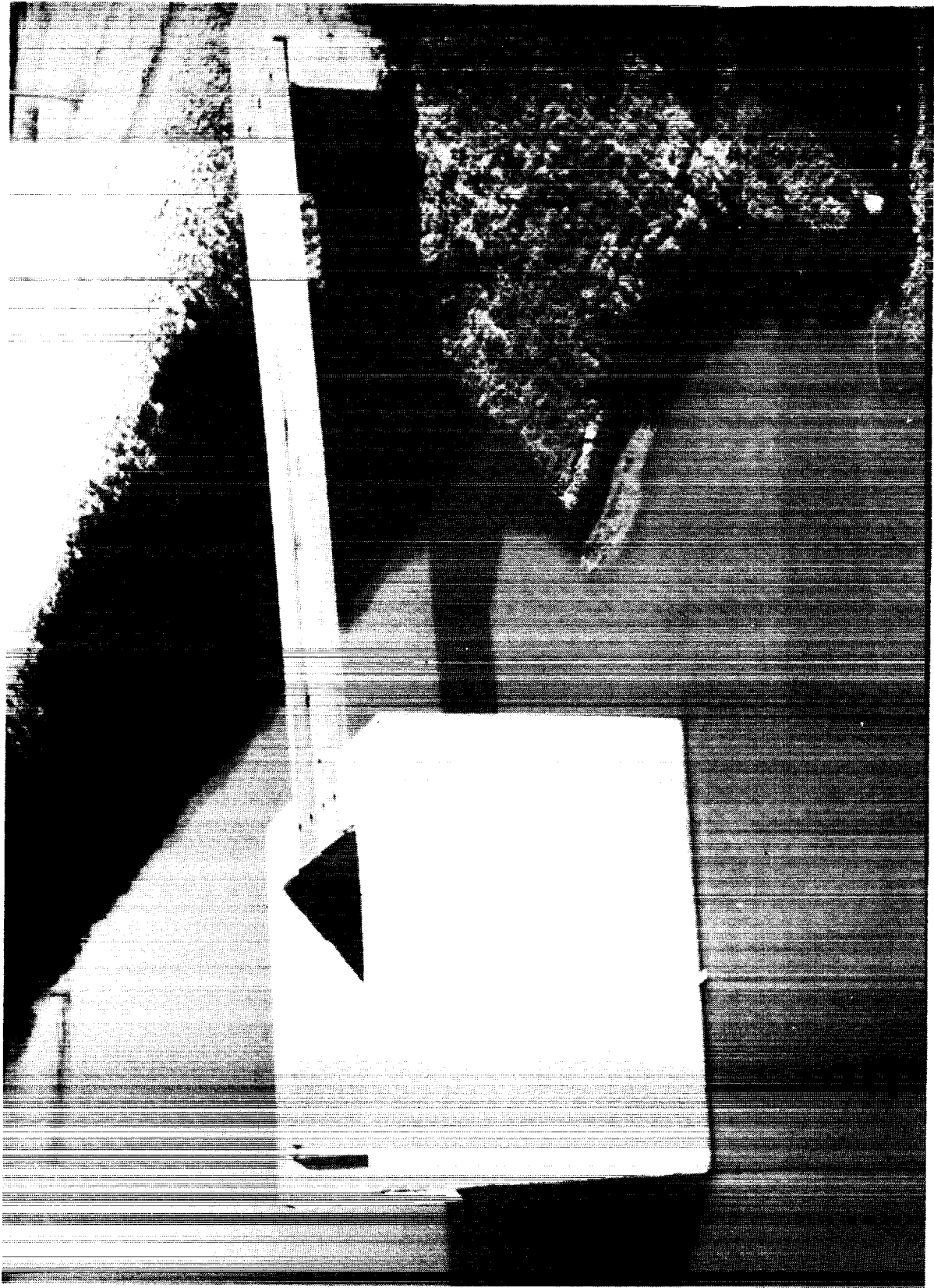


Figure 16. Typical Erosion of an Embankment of a Wastewater Evaporation Pond  
Before Renovation Work Began

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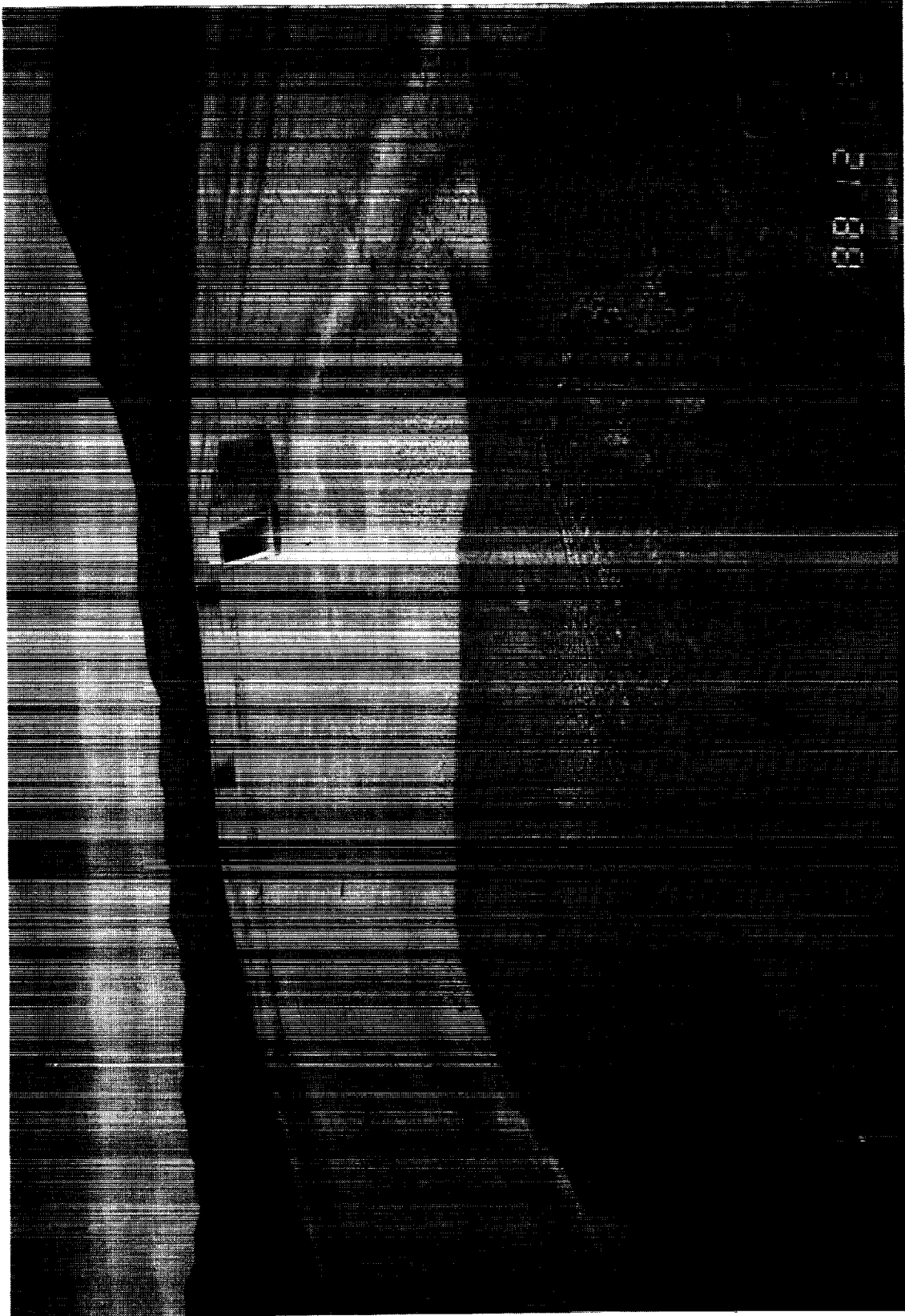


Figure 17. Partial Drainage of a Wastewater Evaporation Pond Before Renovation  
Work Began

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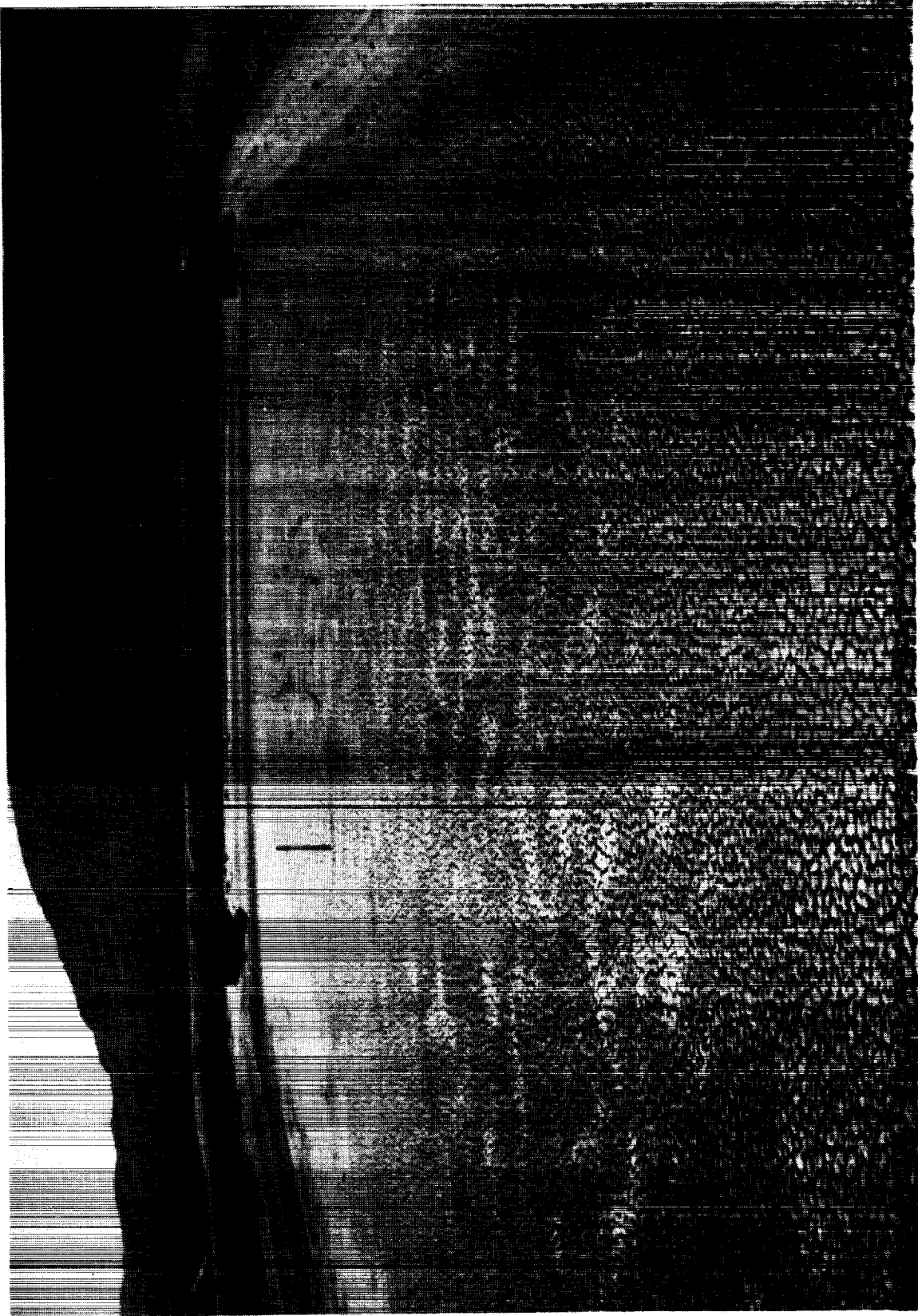


Figure 18. Appearance of an Exposed Dried Bottom of a Wastewater Evaporation Pond



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Figure 19. Earthwork Involving Scraping of Wastewater Evaporation Pond Bottom



Figure 20. Earthwork to Form and Reshape Embankments of Wastewater Evaporation Pond

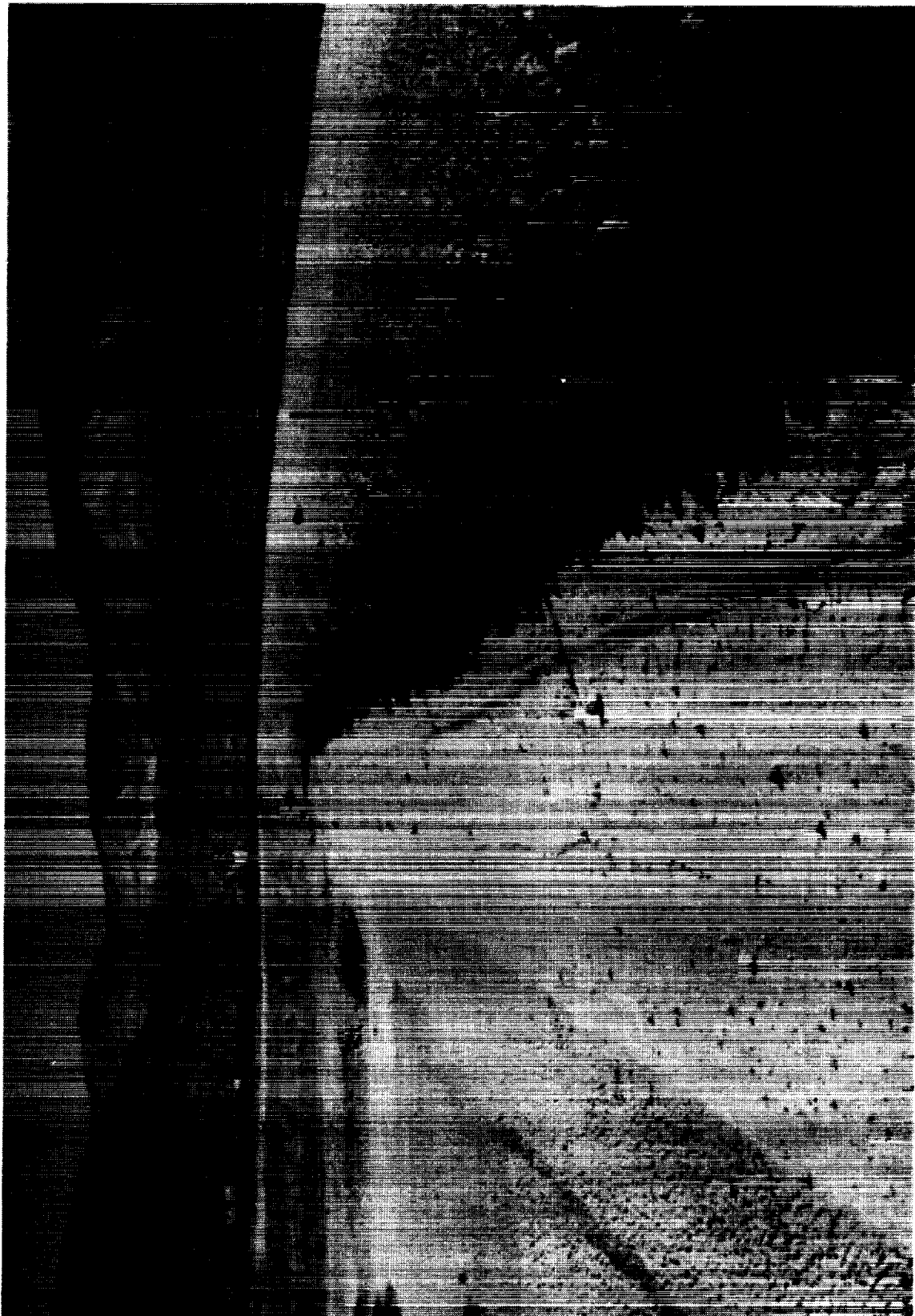


Figure 21. Trenching on Outside of Embankment to Accommodate New Pond Liner

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Figure 22. Earth-Moving Machine Stuck in Pond Mud



Figure 23. Forms and Reinforcing Bars for a Maintenance/Service Ramp for a Wastewater Evaporation Pond



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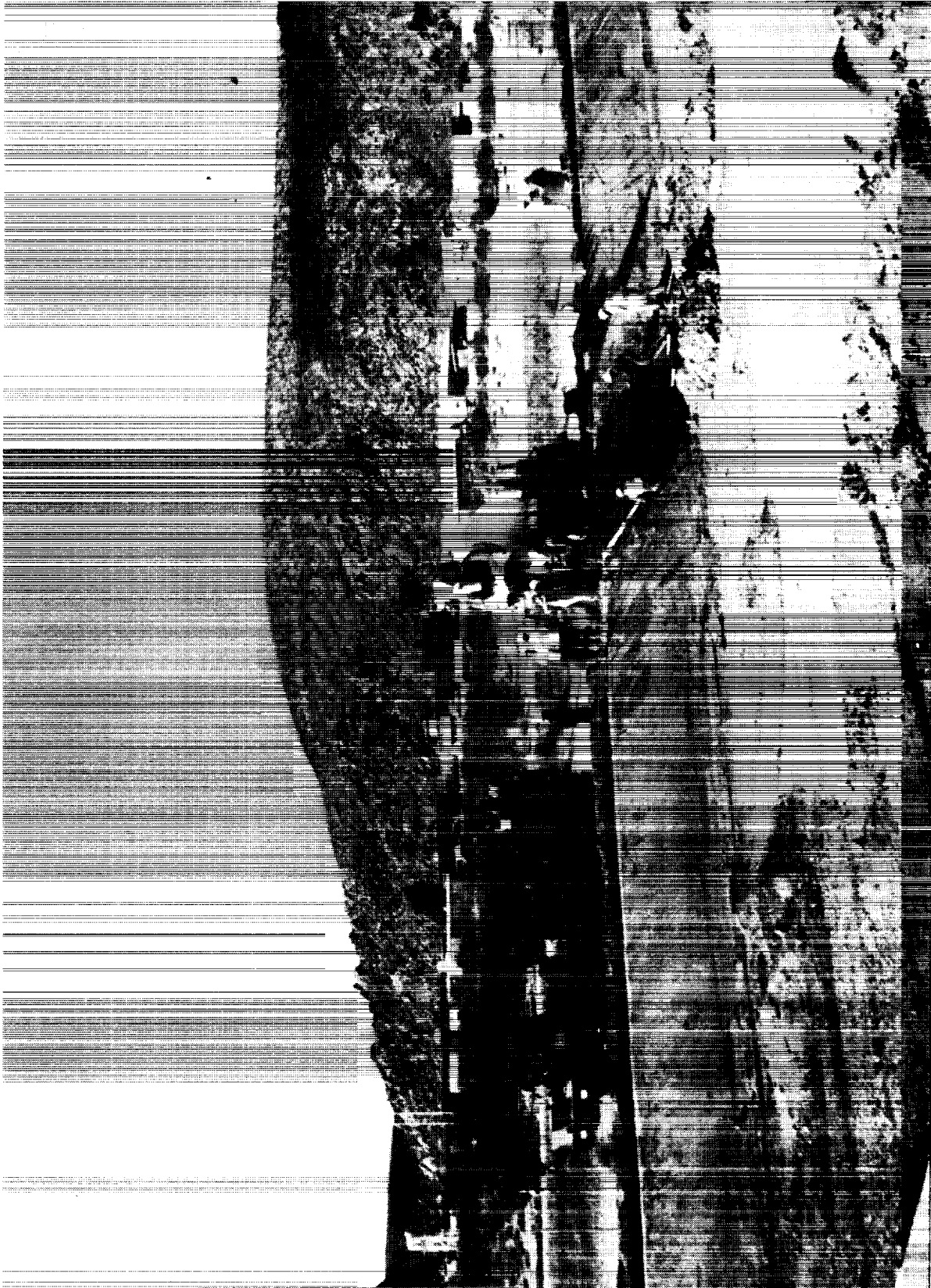


Figure 24. Pouring of Concrete to Form Maintenance Ramp



Figure 25. Finishing of Concrete Surface of Maintenance Ramp (Mars Site)

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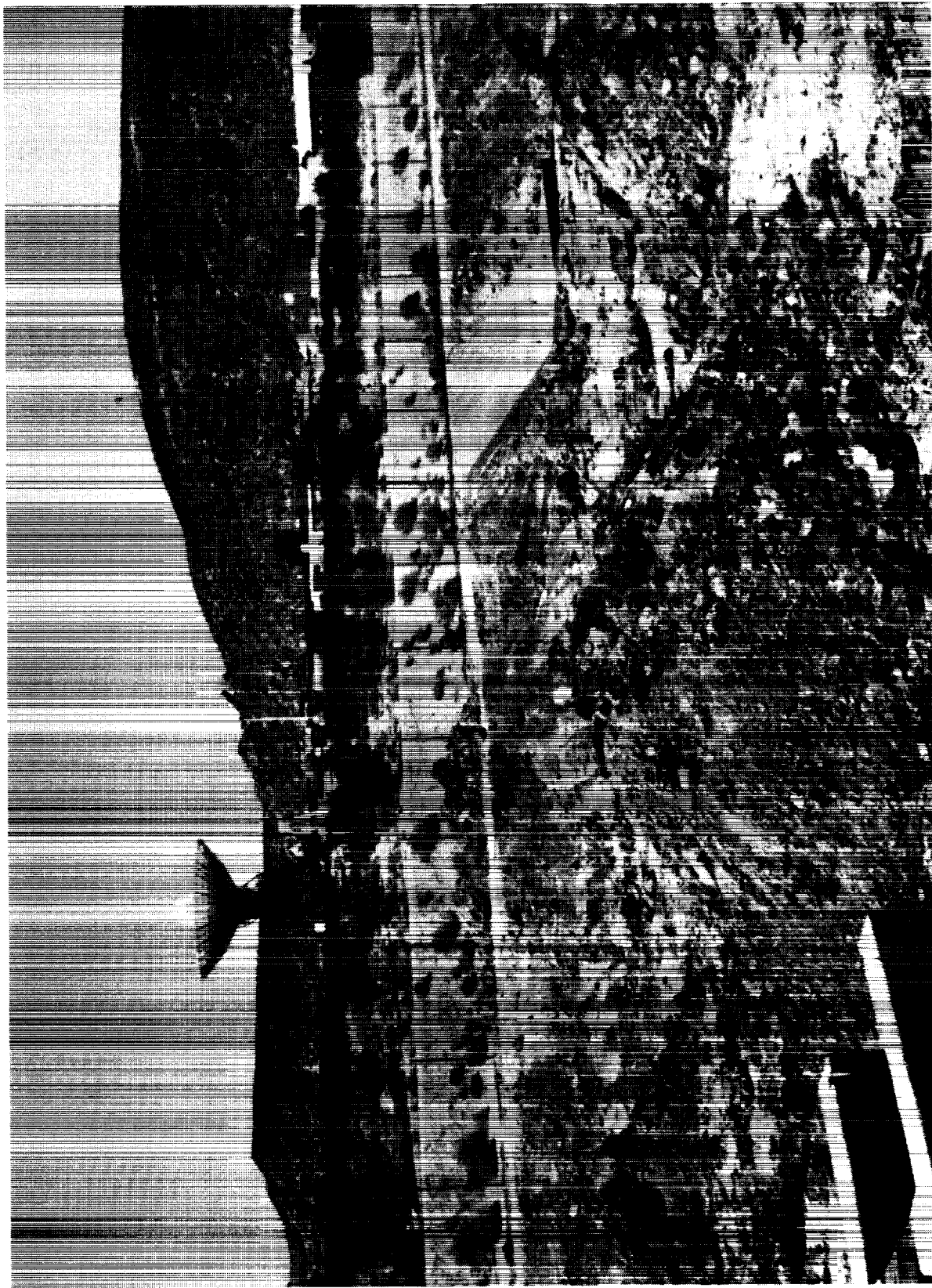


Figure 26. Completed Concrete Maintenance Ramp at a Wastewater Evaporation Pond (Echo Site)



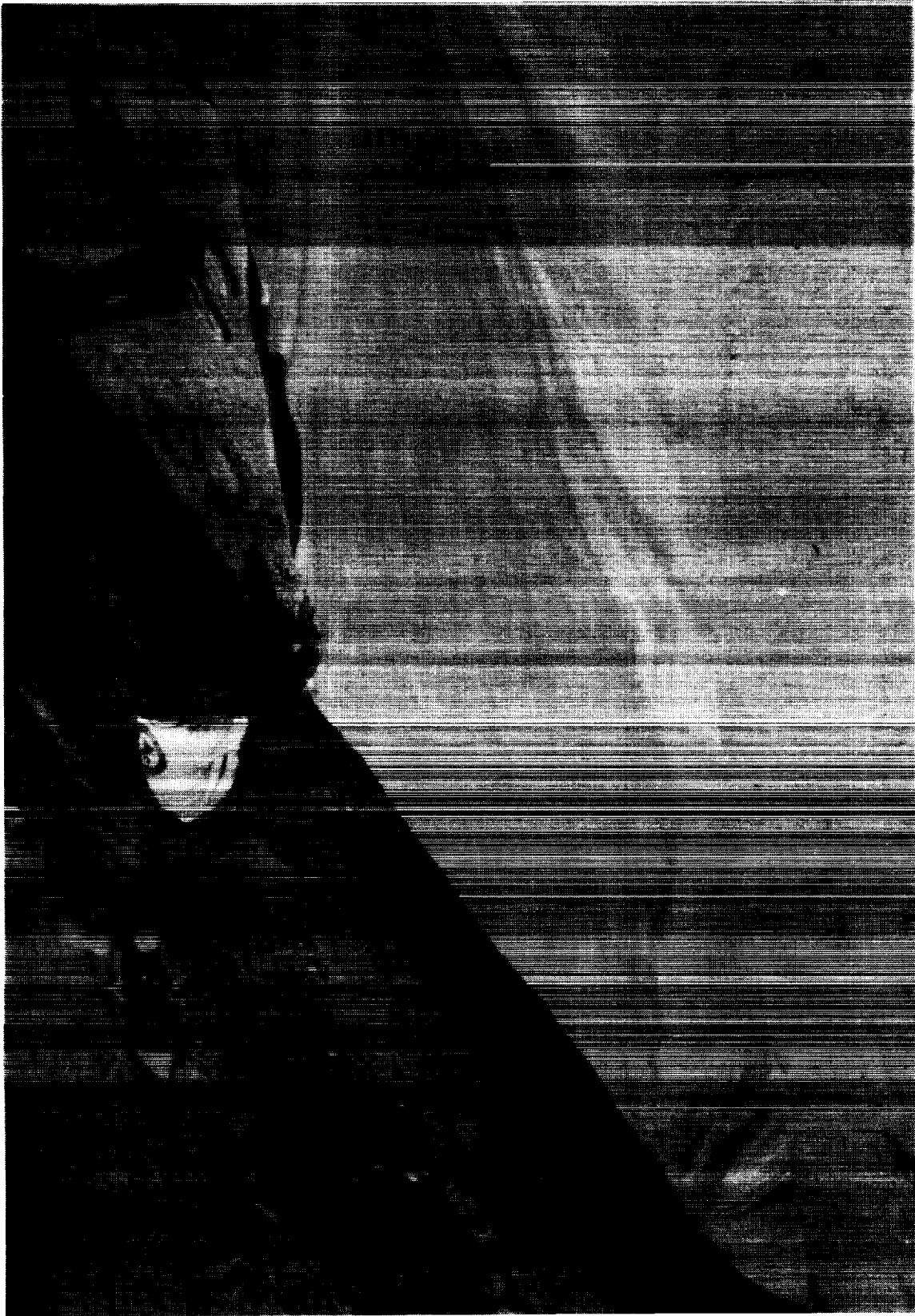


Figure 27. Placing Synthetic Fabric Liner into Trench that Runs Around Inner Perimeter of a Wastewater Evaporation Pond

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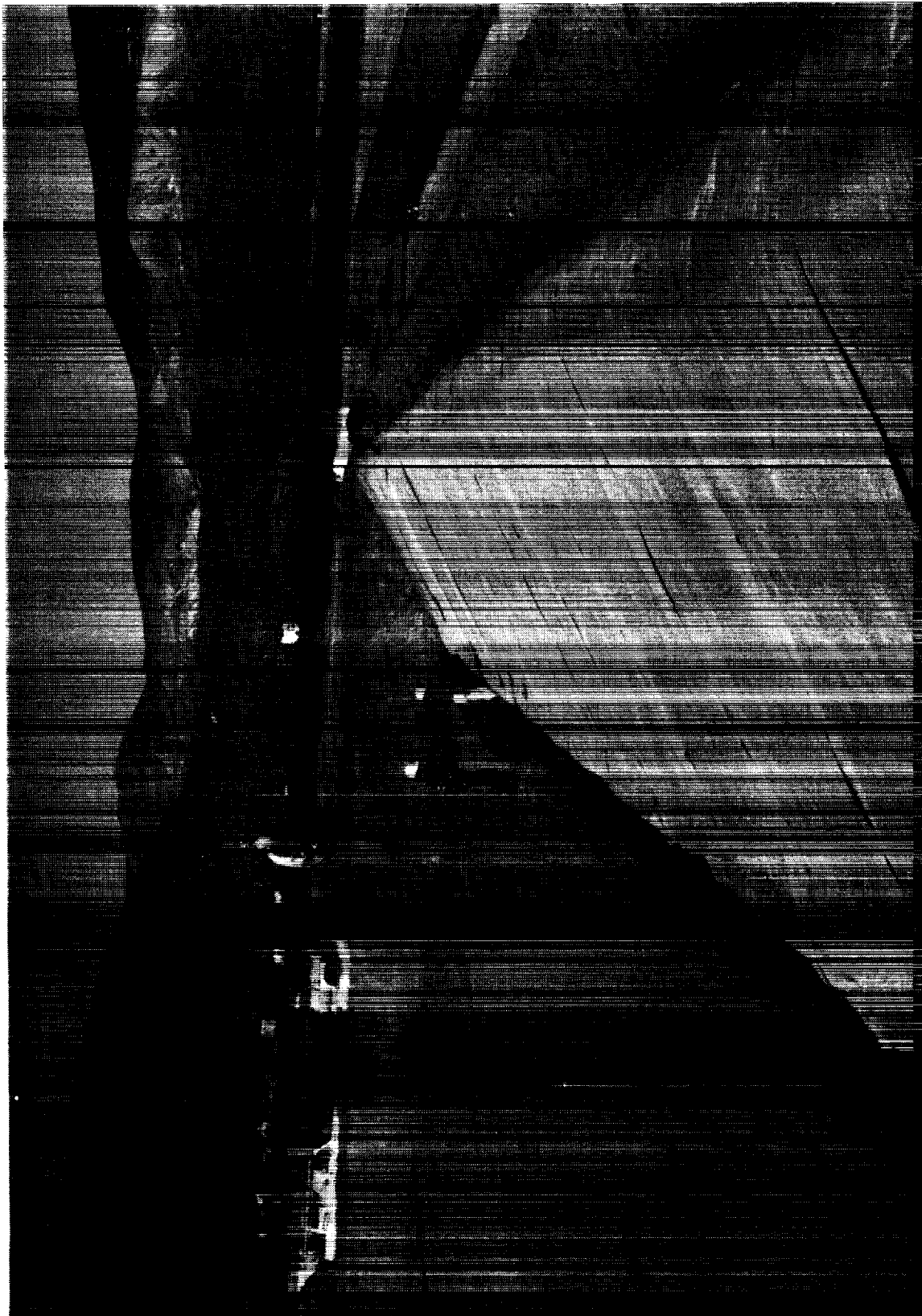


Figure 28. View of Synthetic Liner Covering an Embankment with One End Dipping into the Inner Perimeter Trench (to left), while Other End Dips into the Outer Perimeter Trench (to right)

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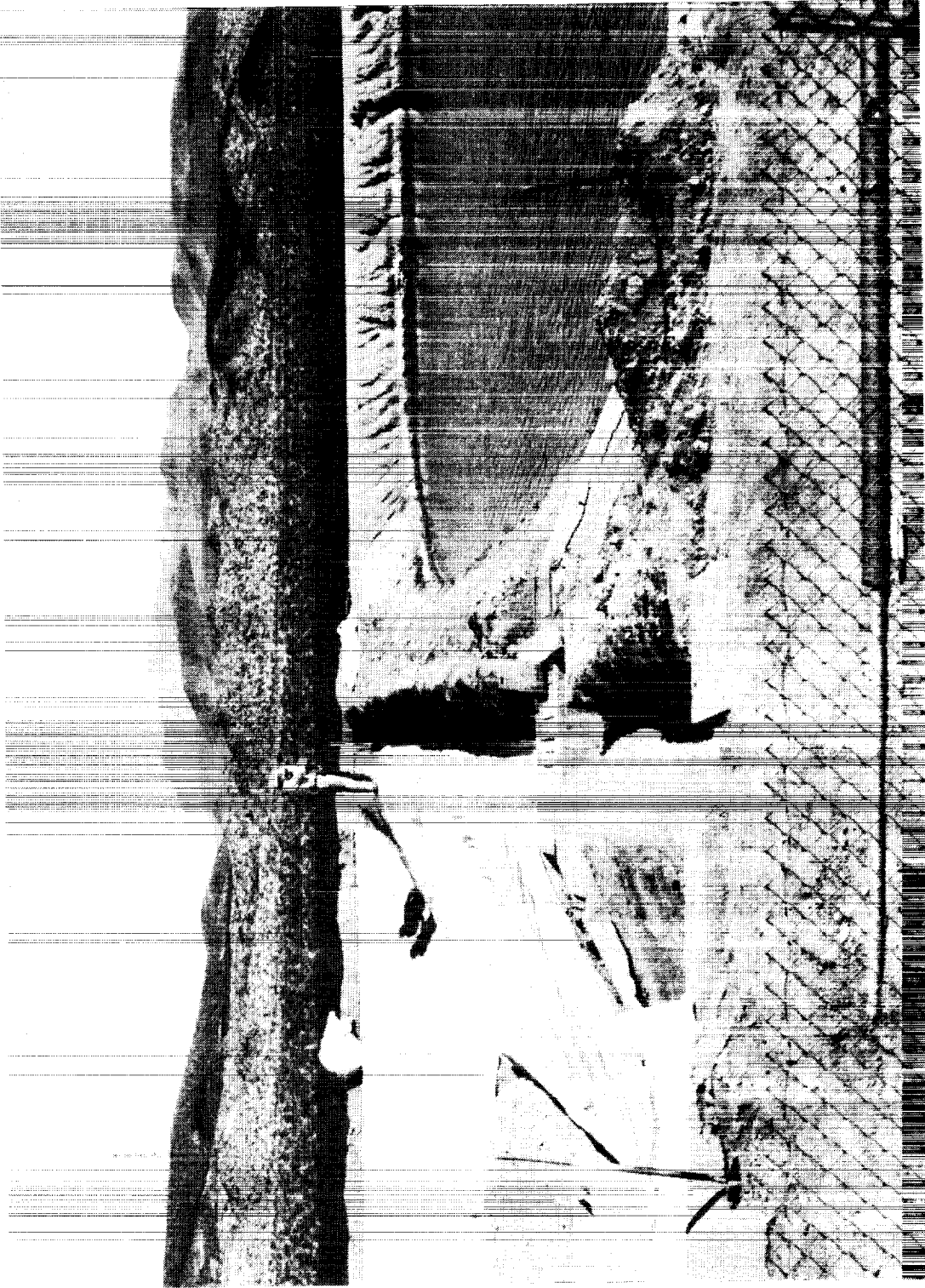


Figure 29. Synthetic Fabric Liner Tucked into Inner Perimeter Trench and also into Outer Perimeter Trench Between Two Back-to-Back Wastewater Evaporation Ponds. Pond on Left is Drained Dry and is Being Renovated, while Pond on Right is in Original Eroded Condition and Filled with Wastewater

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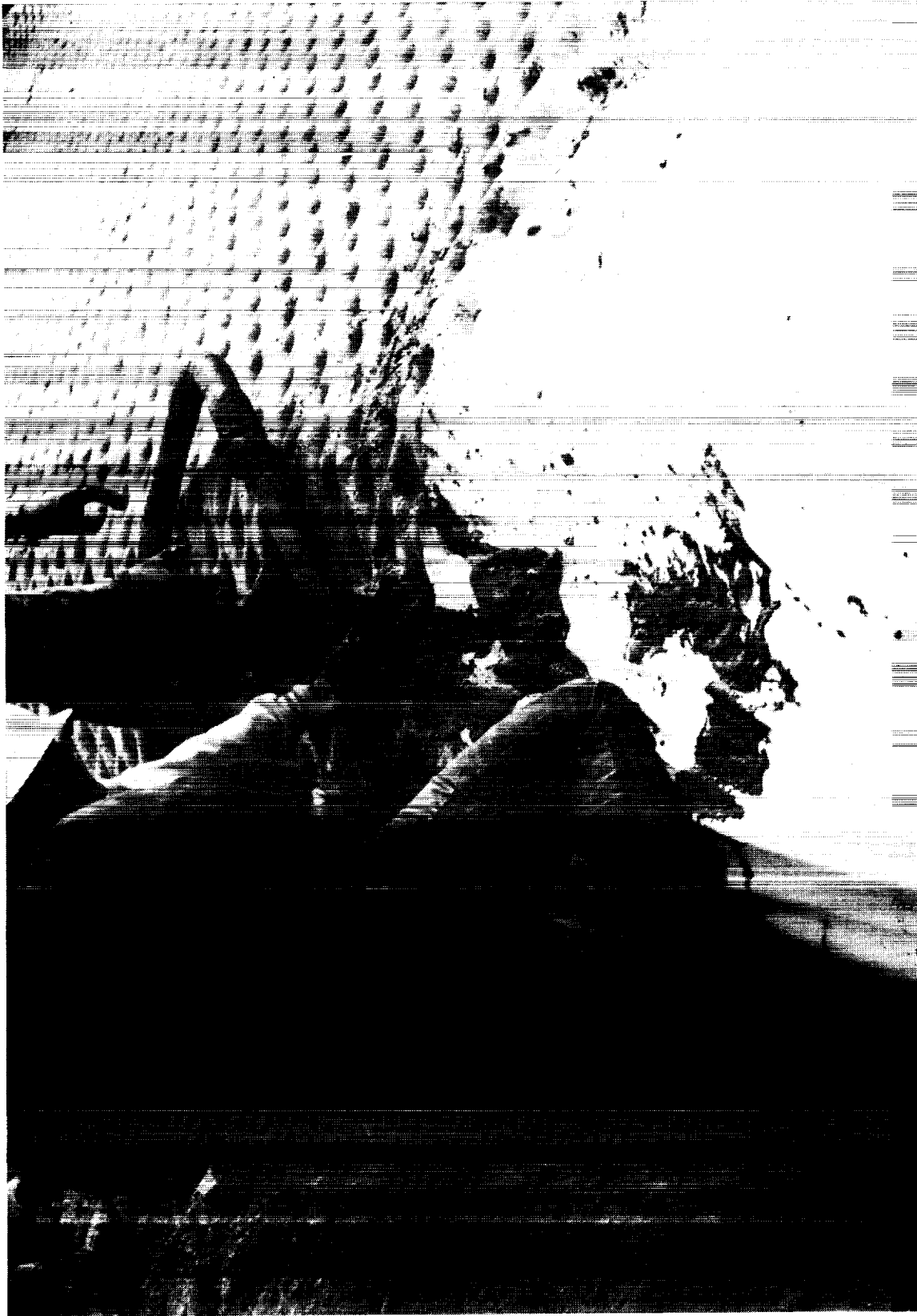


Figure 30. Pumping of Concrete into Double-Layered Synthetic Fabric to Form Concrete-Filled Mattress Liner

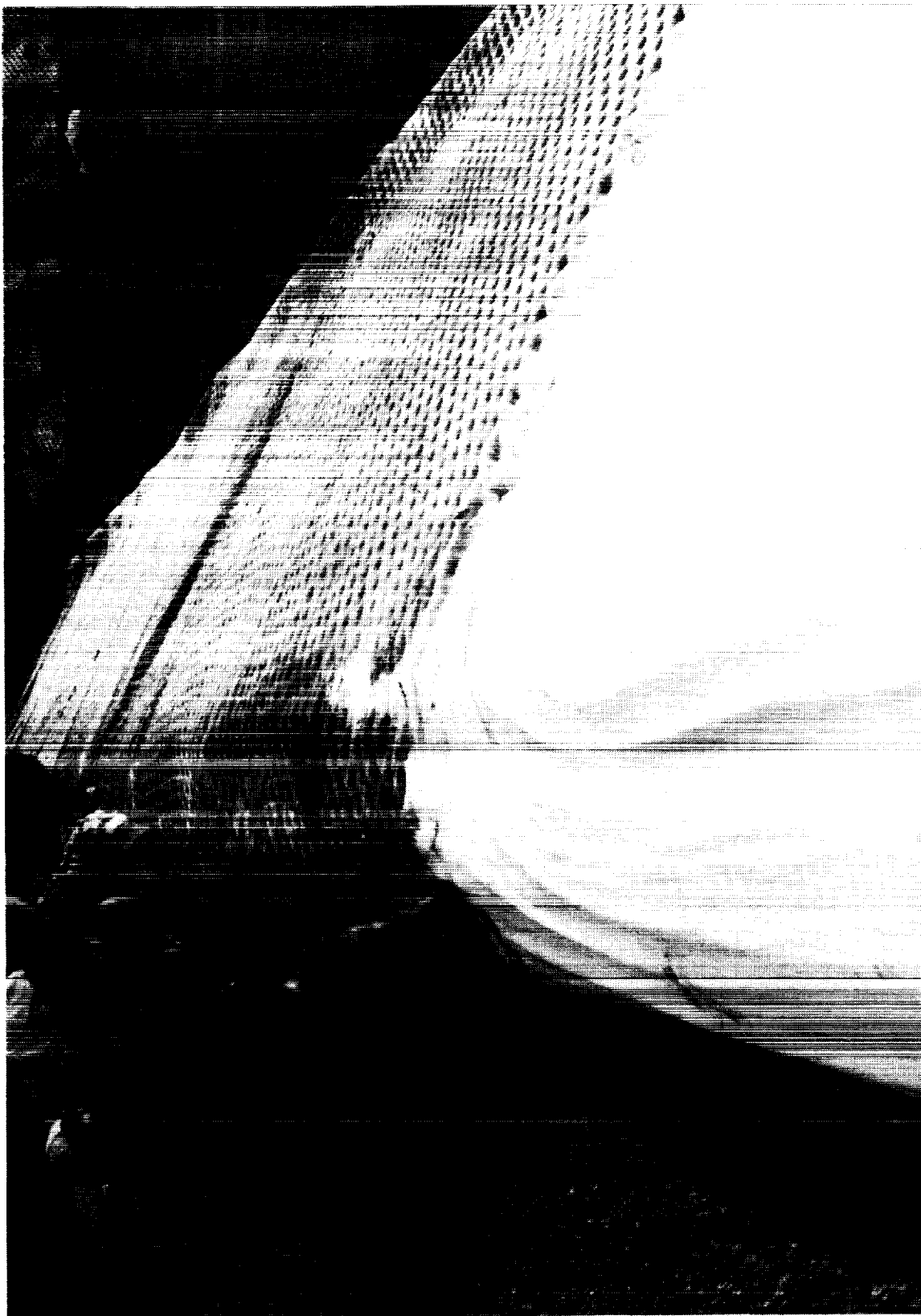


Figure 31. Synthetic Fabric Liner Partially Filled With Concrete

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Figure 32. Wastewater Evaporation Pond with Synthetic Fabric Liner Partially Filled with Concrete



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Figure 33. Wastewater Evaporation Pond with Completed, Concrete-Filled,  
Water-Impervious, Erosion-Control Mattress Covering Embankments

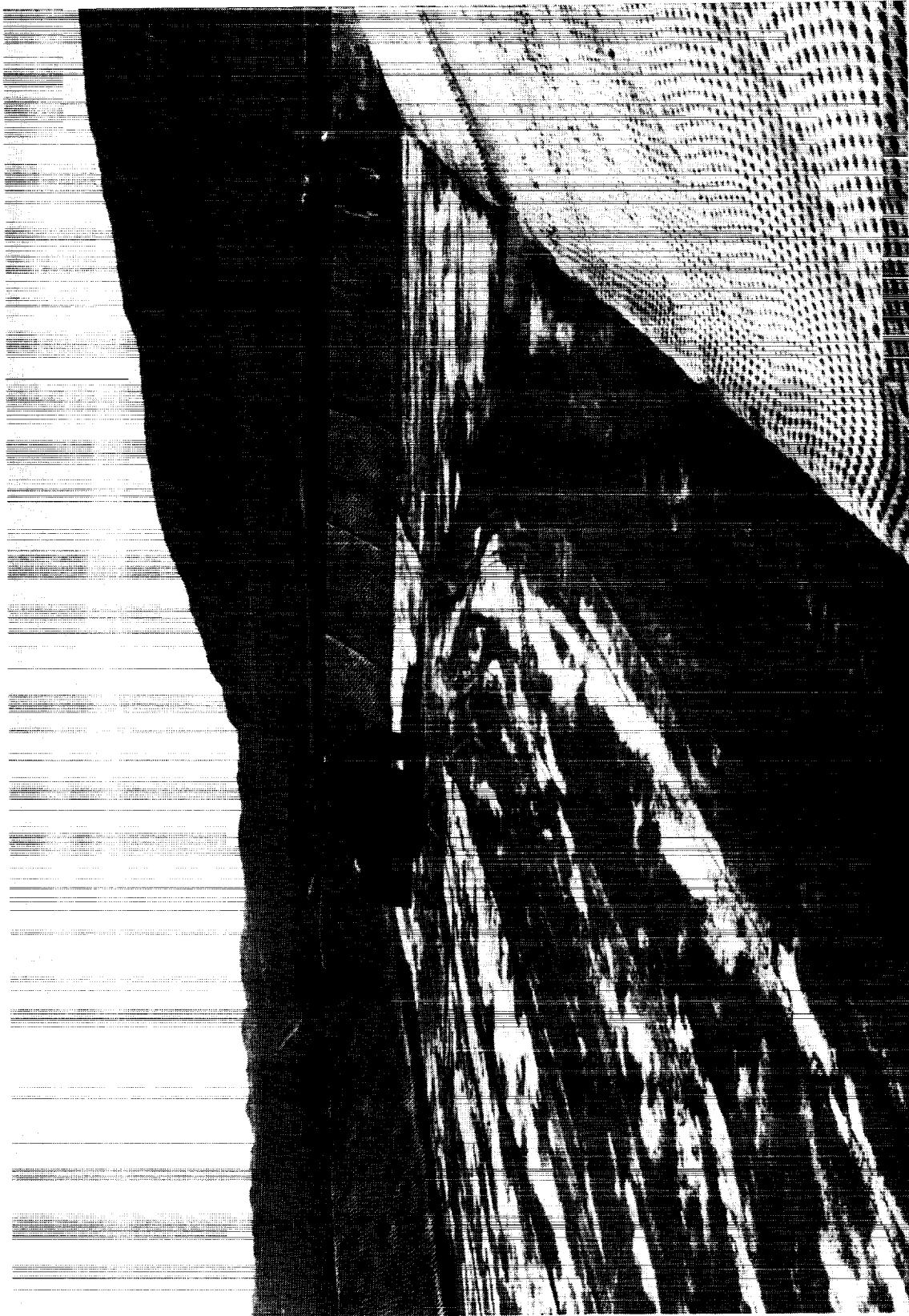


Figure 34. Grading and Cleanup of Bottom of Wastewater Evaporation Pond After Pond Had Been Fitted with a Completed, Concrete-Filled, Erosion-Control Mattress. Note Maintenance Ramp (center right) Projecting onto Pond Bottom



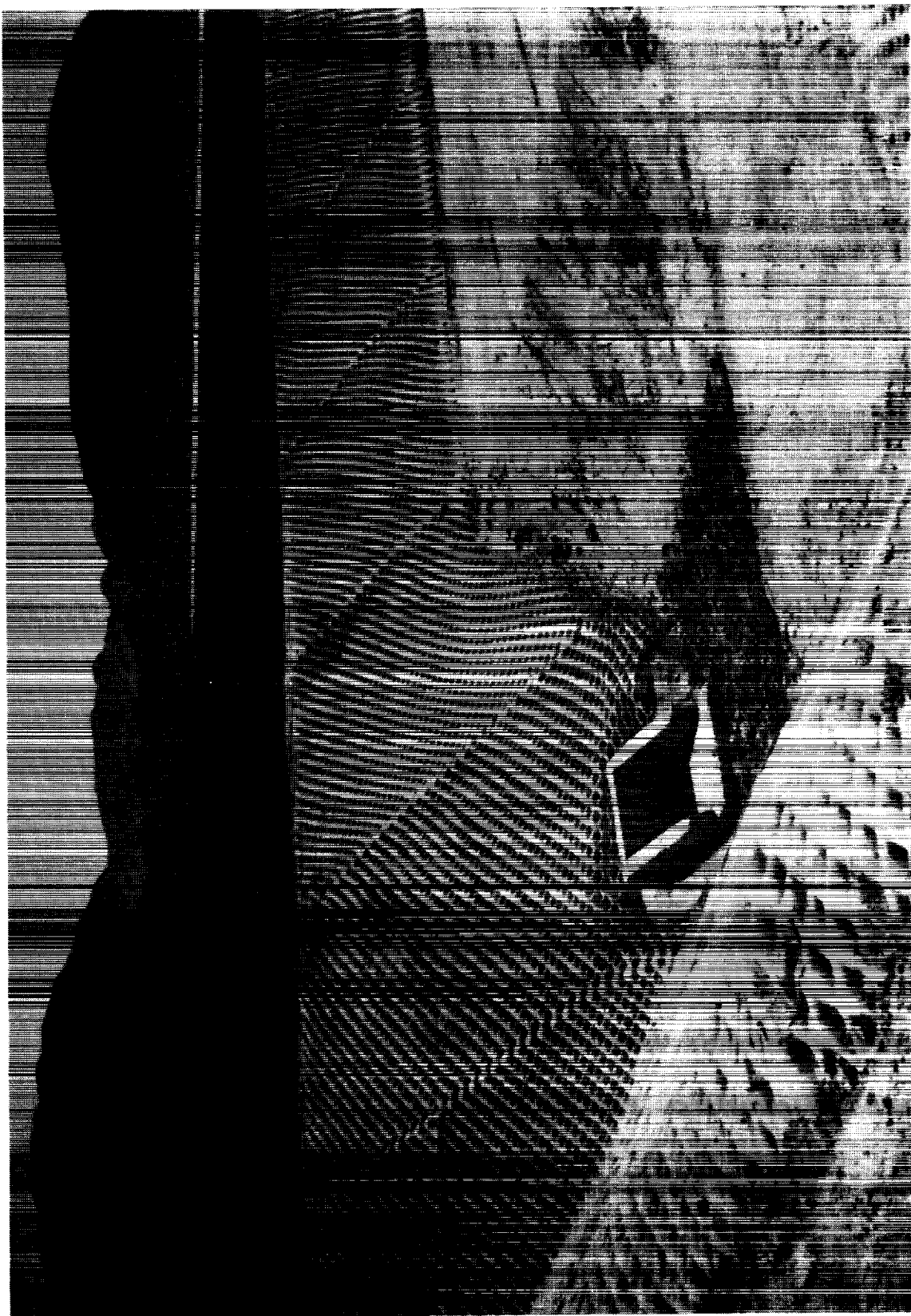


Figure 35. Cleaned Sump Area After Installation of Concrete-Filled,  
Erosion-Control Mattress



Figure 36. Cleaned and Dry Renovated Wastewater Evaporation Pond before  
it is Filled with Wastewater



Figure 37. Newly Renovated Wastewater Evaporation Pond Beginning to  
Fill with Wastewater

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Figure 38. Newly Renovated Wastewater Evaporation Pond Partially Filled with Wastewater

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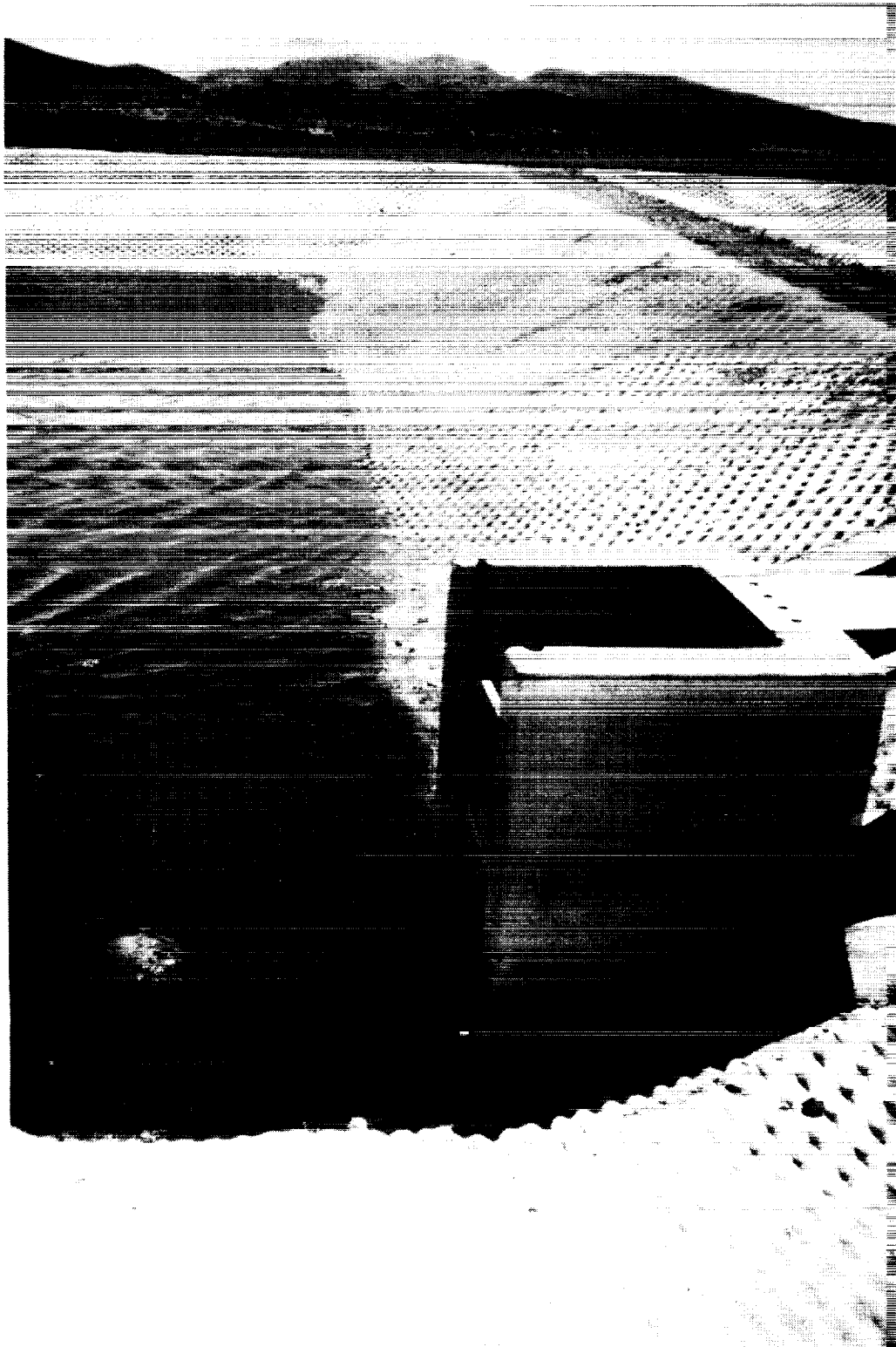


Figure 39. Embankment of Newly Renovated Wastewater Evaporation Pond. Compare with Embankment of Original, Eroded Wastewater Evaporation Pond Depicted in Figure 8.

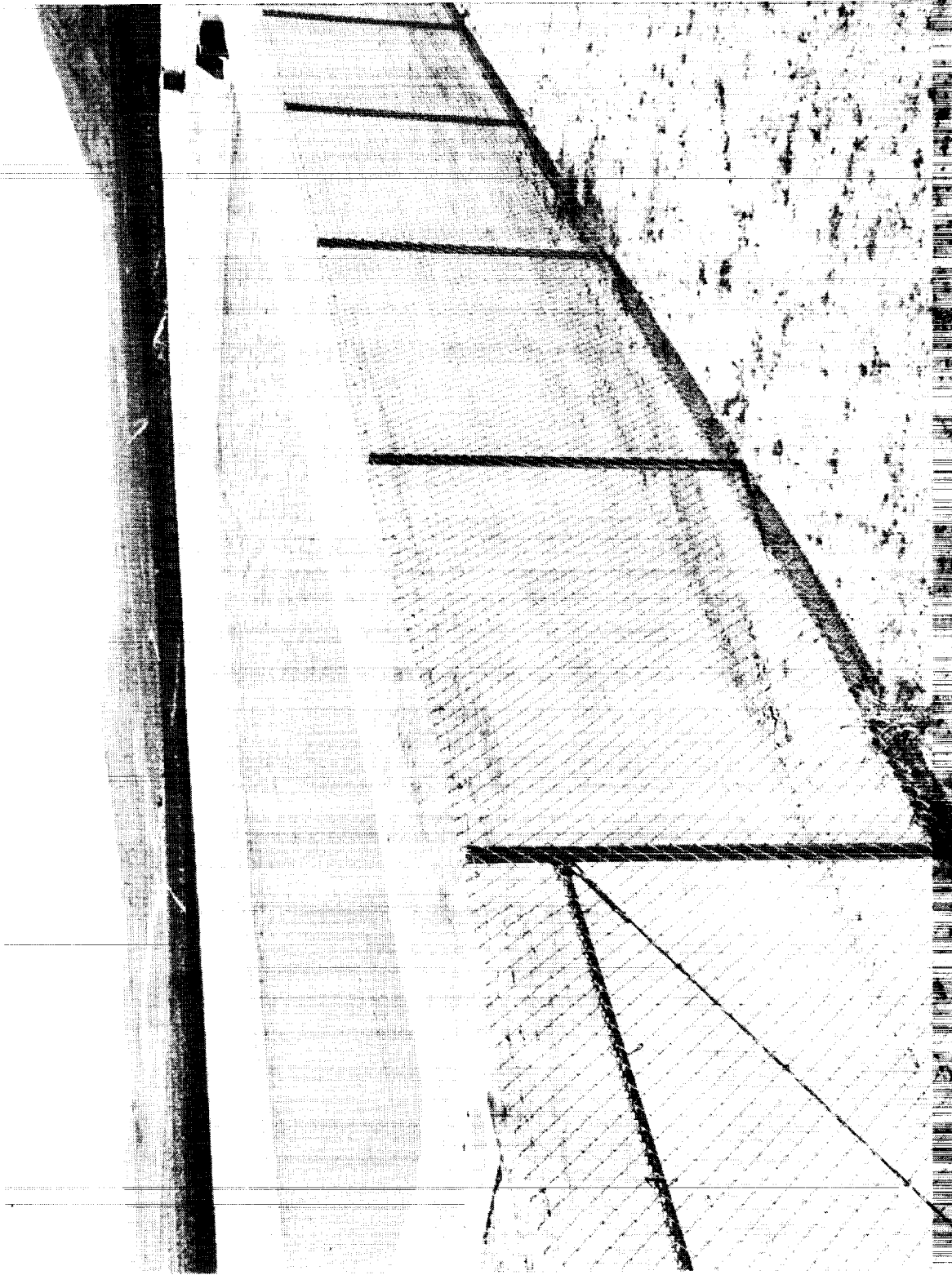


Figure 40. Completely Reshaped and Renovated Wastewater Evaporation Pond with its Concrete-Filled, Water-Impermeable, Erosion-Control Mattress Covering its Embankments

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## SECTION IV

### DETAILS OF THE WASTEWATER EVAPORATION PONDS AT THE ECHO AND MARS SITES

#### A. ECHO SITE

Echo Site, the administrative center of the GDSCC (Figures 41 and 42), has the highest population density of personnel at the Complex. On average, about 110 people work each day at the Echo Site. Thus, the wastewater evaporation ponds at Echo Site are larger than those at the Mars Site, because the latter's smaller number of personnel.

The two wastewater evaporation ponds at the Echo Site, located approximately 1,400 ft southeast of the main building cluster, are configured end-to-end, separated by a common embankment and are oriented north-to-south (Figure 43). Each pond has an area of approximately 19,800 SF and an operating volume of 61,000 cubic ft (456,280 gallons).

#### B. MARS SITE

Two parabolic antennas, DSS-14 and DSS-15, are located at the Mars Site (Figures 44 and 45). Yet, the average number of persons working at the Mars Site is only about 48 persons per day. Thus, at present, the Mars Site's need for evaporation ponds is much less than for the Echo Site.

The two wastewater evaporation ponds at the Mars Site, located south of the main building cluster, have the same end-to-end configuration as the Echo ponds, and are oriented northwest-to-southeast. Each pond has an area of approximately 8,600 SF and an operating volume of 22,700 cubic ft (about 170,000 gal).

#### C. GENERAL FACTS

The dimensions of the Echo and Mars wastewater evaporation ponds are presented in Figure 46. A schematic drawing showing the various dimensions of the concrete-filled, erosion-control mattress that now lines both the Echo and Mars wastewater evaporation ponds is depicted in Figure 47.



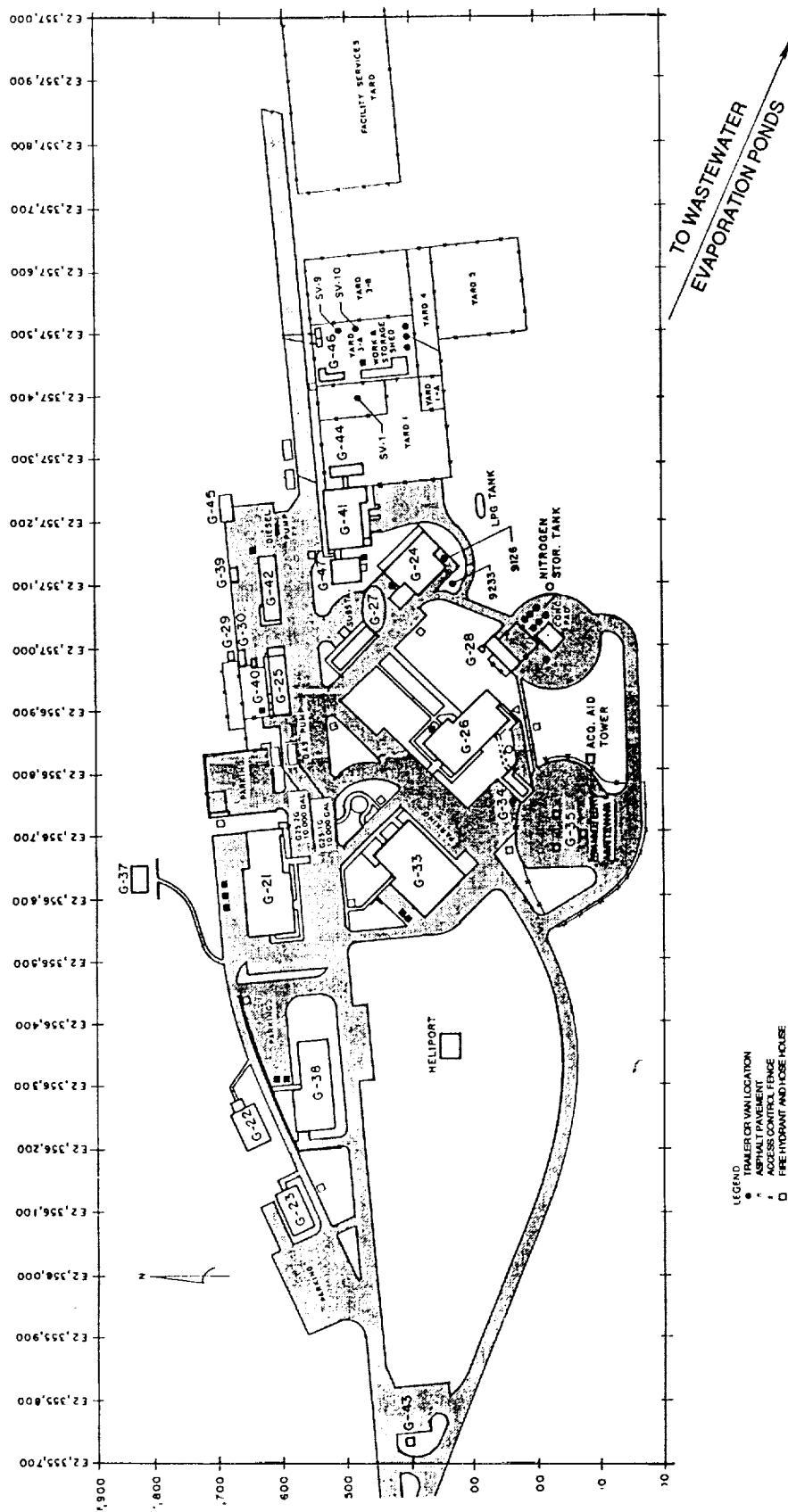
## ECHO STATION DSS 12



Figure 41. Originally built in 1959, the 26-meter (85 ft) antenna first was used in 1960 in support of the Echo Project, an experiment to transmit voice communications coast-to-coast by bouncing radio signals off the surface of a passive balloon-type satellite. In 1978, the antenna was extended to 34-meters (111.5 ft).

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# ECHO SITE PLOT PLAN

SCALE 1" = 240'

- LEGEND
- TRAILER OR VAN LOCATION
  - ASPHALT PAVEMENT
  - ACCESS CONTROL FENCE
  - PERMANENT AND HOSE HOUSE
  - TV TOWER
  - LIGHT TOWER (SURVEILLANCE TV)
  - DUMPSTER LOCATION
  - FUEL TANK
  - DIESEL
  - GASOLINE
  - SEPTIC TANK

Figure 42. Echo Site Plot plan

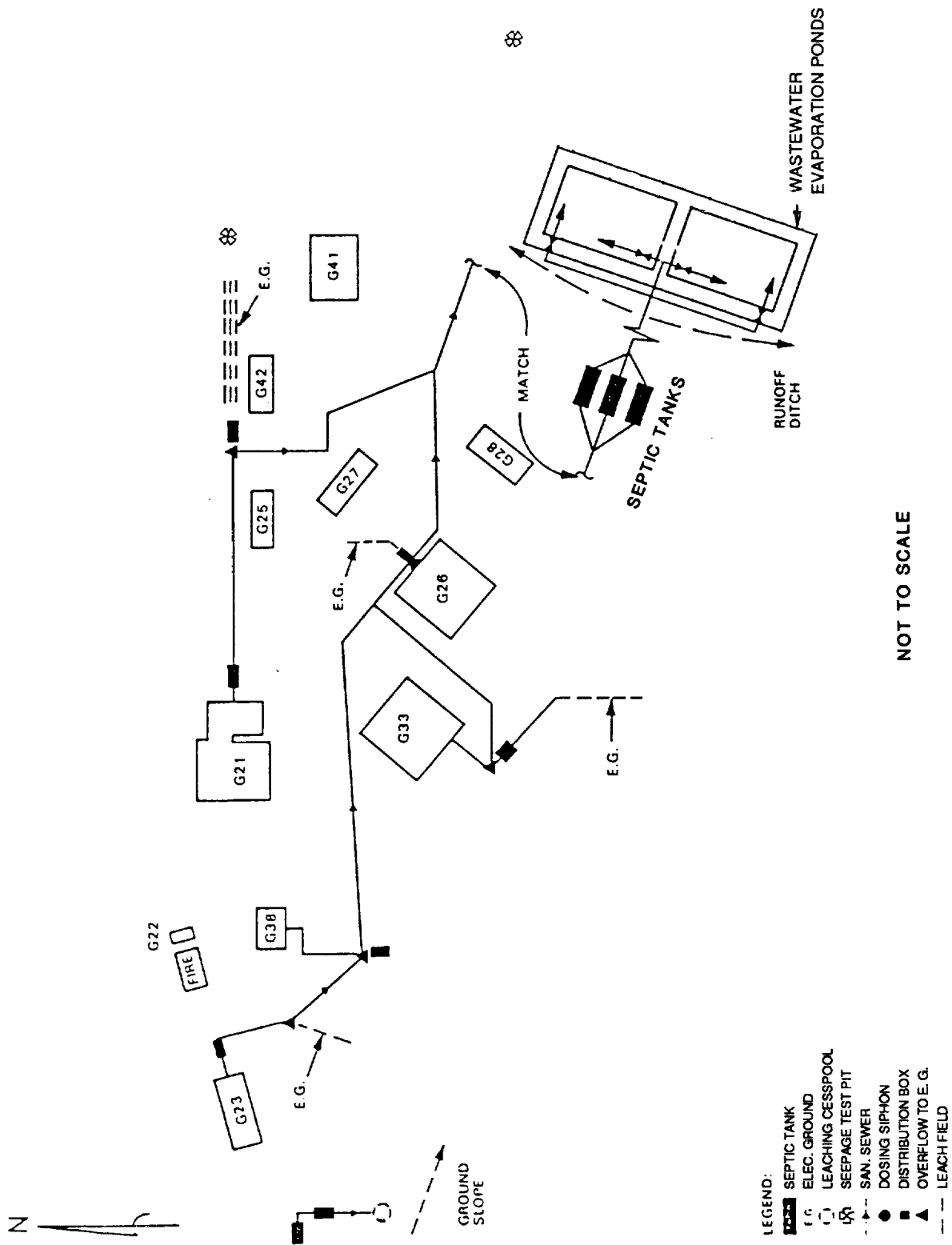


Figure 43. Echo Site: Schematic of Sewage System

MARS STATION  
DSS 14

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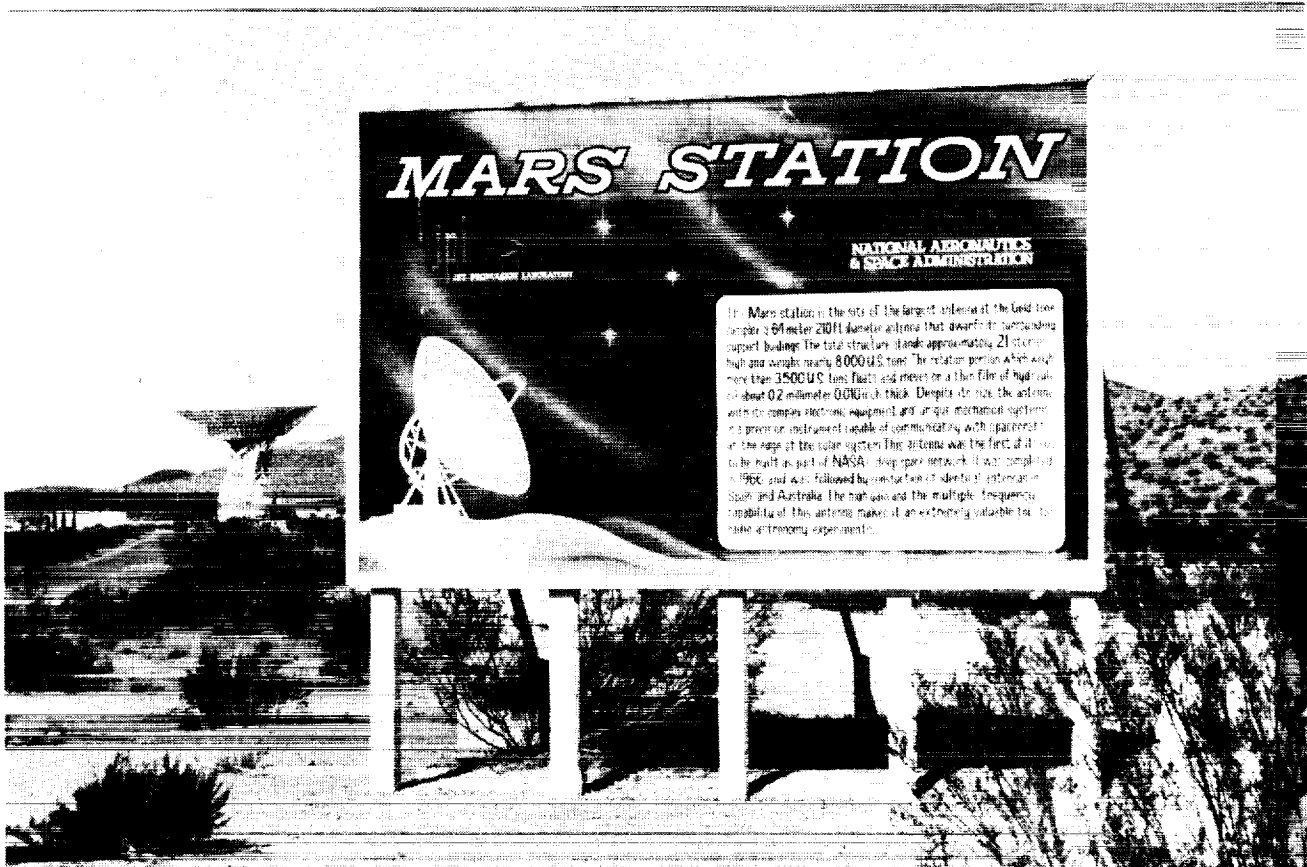
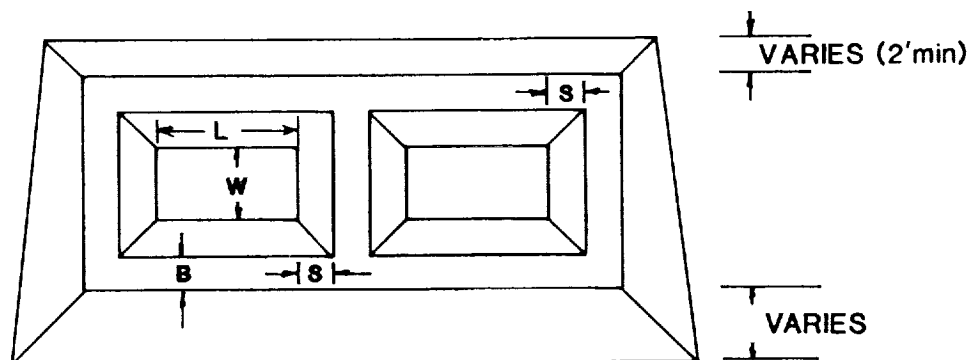


Figure 44. Mars Station. Built in 1966, the 64-meter (210 ft) antenna, standing more than 234 ft tall, permitted the DSN's transmitter power and receiver sensitivity to increase 6.5 times compared to that of a 26-meter antenna. It also extended the range of the DSN into deep space by 2.7 times. The 64-meter parabolic disk was extended to 70 meters (230 ft) in 1988. This permitted the antenna to be ready for Voyager 2 spacecraft's encounter with the planet Neptune in August 1989.





	ECHO	MARS
"L"	182'	110'
"W"	72'	40'
"S"	12'	12'
"B"	8'	8'

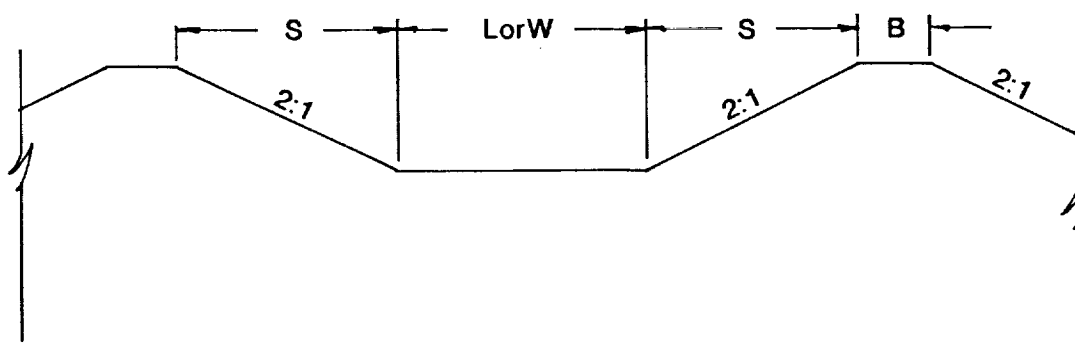


Figure 46. Dimensions of the Pairs of Wastewater Evaporation Ponds at the Echo and Mars Sites

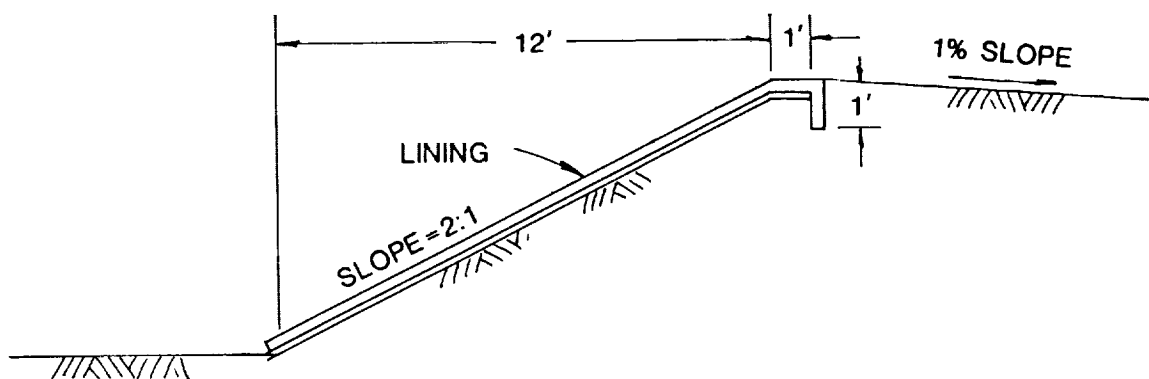


Figure 47. Schematic of Concrete-Filled, Erosion-Control, Mattress-Lining for the Repair of Inner Embankments of Wastewater Evaporation Ponds

SECTION V  
CERTIFICATION

I hereby certify that all work performed by Engineering-Science, Inc., Pasadena, California, and the Jenkin Construction Company, Long Beach, California, in their work pertaining to the renovation and modification of four functioning wastewater evaporation ponds at the Goldstone Deep Space Communications Complex of the Ft. Irwin Military Reservation, San Bernardino County, California, as described in this report, was performed in compliance with Federal, state, and local regulations, and in accordance with good engineering practice.

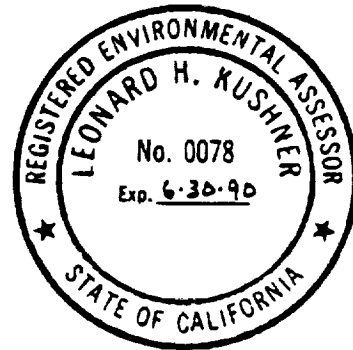
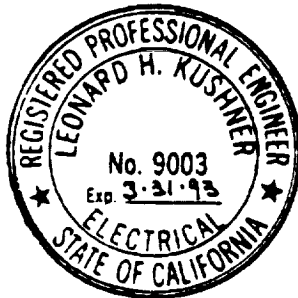
Leonard H. Kushner  
Registered Professional Engineer

Signature Leon Kushner

Date Signed: September 27, 1989

Registration No.	E9003, Electrical	State:	California
	SF1086, Safety		California
	EA 0078 Environmental Assessor		California

Stamp/Seal



APPENDIX A

WASTEWATER DISCHARGE REQUIREMENTS  
FOR WASTEWATER EVAPORATION PONDS



CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
LAHONTAN REGION

BOARD ORDER NO. 6-85-7

REVISED WASTE DISCHARGE REQUIREMENTS

FOR

GOLDSTONE TRACKING STATION  
ECHO, MARS AND PIONEER SITES  
San Bernardino County

The California Regional Water Quality Control Board, Lahontan Region finds:

1. The Board previously established waste discharge requirements for Goldstone Tracking Station - Echo, Mars and Pioneer sites under Board Order Nos. 6-72-74, 6-72-76 and 6-72-75, respectively, which were adopted on October 26, 1972. For the purposes of this order, the National Aeronautics and Space Administration - Jet Propulsion Laboratory is hereinafter referred to as the "discharger".
2. The Board is revising waste discharge requirements at this time to update them.
3. The Goldstone Tracking Station is located approximately 35 miles (56 km) north of the City of Barstow.
4. The Echo Site collects, treats and disposes of an average of 1,200 gpd (4,500 l/d) of domestic wastewater. The treatment and disposal facilities are located in the Bicycle Hydrologic Unit within the NE/4 Section 19, T14N, R2E, SBB&M as shown on Attachment "A", which is made a part of this order.
5. The Mars Site collects, treats and disposes of an average of 420 gpd (1,590 l/d) of domestic wastewater. The treatment and disposal facilities are located in the Robbers Subunit of the Panamint Hydrologic Unit within the NW/4 Section 9, T15N, R1E, SBB&M as shown on Attachment "B", which is made a part of this order.
6. The Pioneer Site collects, treats and disposes of an average of 210 gpd (800 l/d) of domestic wastewater. The treatment and disposal facilities are located in the Nelson Subunit of the Nelson Hydrologic Unit within the SW/4, Section 14, T15N, R1E, SBB&M as shown on Attachment "B", which is made a part of this order.
7. Each site consists of a tracking station for the National Aeronautics and Space Administration - Jet Propulsion Laboratory (NASA - JPL) Deep Space Network. Approximately 60, 12 and 14 people currently work each day at the Echo, Mars and Pioneer Sites, respectively.

8. Wastewater at the Echo Site is discharged to 12 septic tanks with a total capacity of 18,000 gallons (68,000 liters). Septic tank effluent is discharged to two 0.4-acre (0.16 hectare) percolation/oxidation ponds and a small leachfield.
9. Wastewater at the Mars Site is discharged to 4 septic tanks with a total capacity of 5,000 gallons (18,900 liters). Septic tank effluent is discharged to two 0.16-acre (0.07 hectare) percolation/oxidation ponds and a small leachfield.
10. Wastewater at the Pioneer Site is discharged to 6 septic tanks with a total capacity of 6,000 gallons (22,700 liters). Septic tank effluent is discharged to two 0.11-acre (0.04 hectare) percolation/oxidation ponds and a small leachfield.
11. The percolation/oxidation ponds and the leachfields are the only designated disposal sites.
12. The disposal sites are underlain by unconsolidated Quarternary alluvial deposits. A well located 3.0 miles (4.8 km) east of the Echo Site was dry when drilled to a depth of 335 feet (102 m). The top of this well is 350 feet (107 m) lower in elevation than the disposal area. Depth to groundwater in the nearest water well [3.5 miles (5.6 km) southwest] to the Mars site is greater than 140 feet (43 m). Total filtrable residue content of the groundwater exceeds 1,000 mg/l. Depth to groundwater in a well 5 miles (8 km) southwest of the Pioneer Site is greater than 150 feet (45 m). The total filtrable residue concentration of the groundwater is greater than 2,000 mg/l.
13. The designated disposal sites are located on land owned by the U.S. Government and controlled by the NASA - JPL.
14. The Board adopted the Water Quality Control Plan for the South Lahontan Basin on May 8, 1975, and this order implements that plan.
15. The beneficial uses of the groundwaters of the Bicycle Hydrologic Unit (Echo Site) as set forth and defined in the plan are:
  - a. municipal and domestic supply
  - b. industrial service
  - c. freshwater replenishment
16. The beneficial uses of the groundwaters of the Robbers Subunit of the Panamint Hydrologic Unit (Mars Site) as set forth and defined in the plan are:
  - a. municipal and domestic supply
  - b. industrial service

17. The beneficial uses of the groundwaters of the Nelson Subunit of the Nelson Hydrologic Unit (Pioneer Site) as set forth and defined in the plan are:
  - a. municipal and domestic supply
18. The Board has notified the discharger and interested agencies and persons of its intent to revise waste discharge requirements for these discharges.
19. These waste discharge requirements govern existing facilities which the discharger is currently operating. The project consists only of the continued operation of the existing facilities governed by these waste discharge requirements and is therefore exempt from the provisions of the California Environmental Quality Act (Public Resources Code Section 21000 et seq.) in accordance with Section 15301, Chapter 3, Title 14, California Administrative Code.
20. The Board in a public meeting heard and considered all comments pertaining to the discharges.

IT IS HEREBY ORDERED, that the discharger shall comply with the following:

I. DISCHARGE SPECIFICATIONS

A. EFFLUENT LIMITATIONS

1. The total flow of wastewater to the treatment and disposal facilities during a 24-hour period shall not exceed 22,500 gallons (85,200 liters), 5,200 gallons (19,700 liters), or 6,500 gallons (24,600 liters) at the Echo, Mars or Pioneer Sites, respectively.
2. The discharge of wastewater except to the designated disposal sites is prohibited.
3. The discharge to waters of the State shall contain no trace elements, pollutants or contaminants, or combinations thereof, in concentrations which are toxic or harmful to humans or to aquatic or terrestrial plant or animal life.

B. RECEIVING WATER LIMITATIONS

1. The waste discharge shall not result in any perceptible color, odor, taste or foaming in surface or groundwaters of the Bicycle Hydrologic Unit, the Robbers Subunit of the Panamint Hydrologic Unit, or the Nelson Subunit of the Nelson Hydrologic Unit.
2. The discharge shall not result in coliform organisms attributable to human wastes to be present in the surface or groundwaters of the Bicycle, Panamint or Nelson Hydrologic Units.

3. The discharge shall not cause there to be in any surface or groundwaters of the Bicycle, Panamint or Nelson Hydrologic Units toxic substances that individually, collectively or cumulatively cause detrimental physiological responses in human, plant, animal, or aquatic life.

C. GENERAL REQUIREMENTS

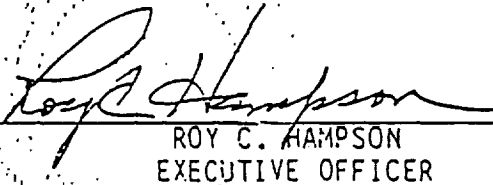
1. There shall be no discharge, bypass or diversion of raw or partially treated sewage, sewage sludge, grease or oils from the collection, transport, treatment or disposal facilities to adjacent land areas or surface waters.
2. Surface flow or visible discharge of sewage or sewage effluent from the designated disposal sites to adjacent land areas or surface water is prohibited.
3. All facilities used for collection, transport, treatment or disposal of wastes shall be adequately protected against either structural damage or a significant reduction in efficiency resulting from a storm or flood having a recurrence interval of once in 100 years.
4. The vertical distance between the water surface elevation and the lowest point of a pond dike or the invert of an overflow structure shall not be less than 1.5 feet (0.46 m).
5. The discharge shall not cause a pollution.
6. Neither the treatment nor the discharge shall cause a nuisance.

II. PROVISIONS

1. Board Orders No. 6-72-74, 6-72-76 and 6-72-75 are hereby rescinded.
2. The discharger shall comply with Monitoring and Reporting Program No. 85-7 as specified by the Executive Officer.
3. The discharger shall immediately notify the Regional Board by telephone whenever an adverse condition occurs as a result of this discharge; written confirmation shall follow.
4. Any proposed material change in the character of the waste, manner or method of treatment or disposal, increase of discharge, or location of discharge shall be reported to this Regional Board at least ninety (90) days in advance of implementation of any such proposal.
5. The California Regional Water Quality Control Board, Lahontan Region hereby reserves the privilege of changing all or any portion of this order upon legal notice to and after opportunity to be heard is given to all concerned parties.

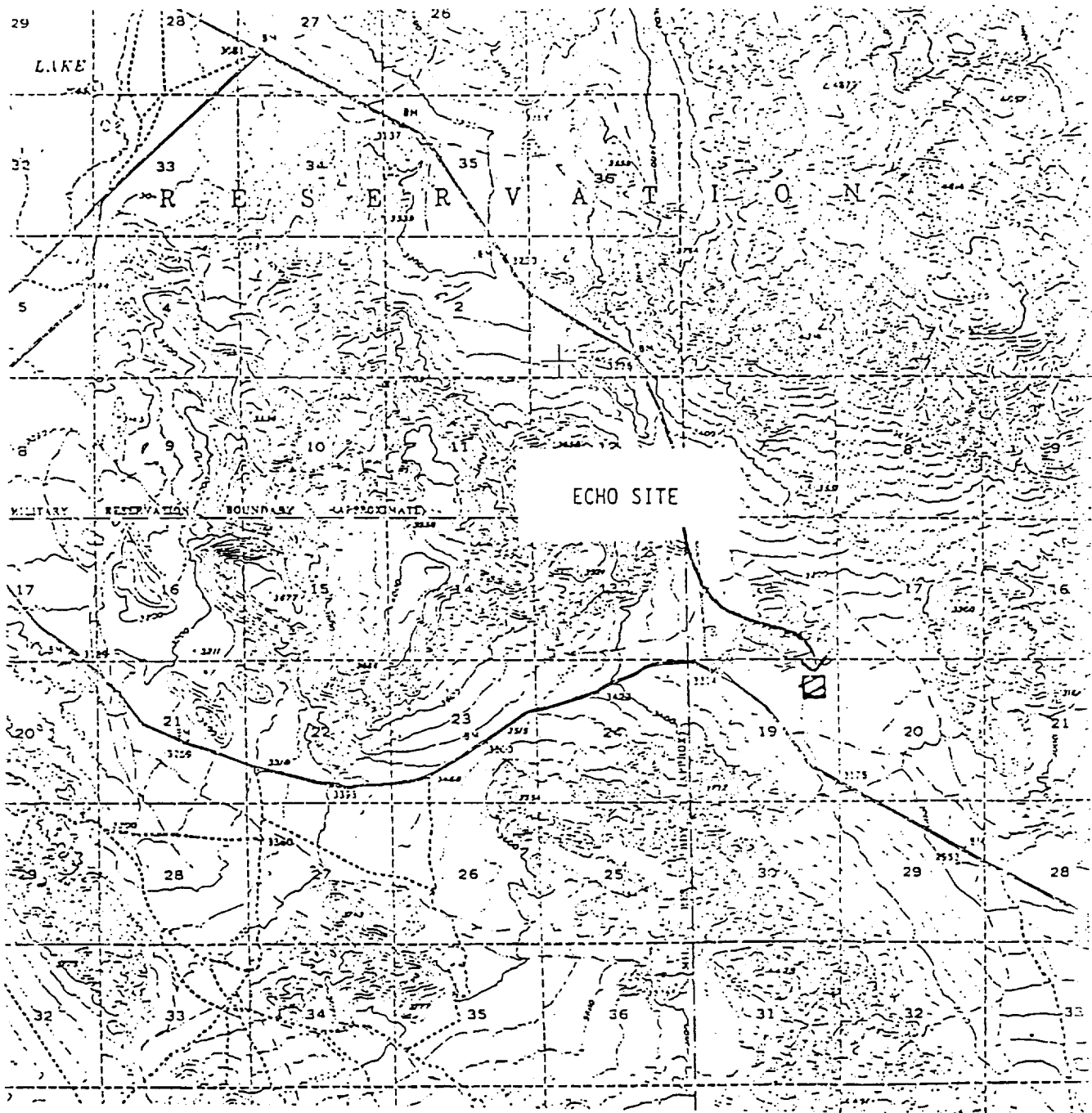
6. Surface waters, as used in this order, include, but are not limited to, live streams, either perennial or ephemeral, which flow in natural or artificial watercourses and natural lakes and artificial impoundments of waters within the State of California.
7. The owner of property subject to waste discharge requirements shall be considered to have a continuing responsibility for ensuring compliance with applicable waste discharge requirements in the operation or use of the owned property. Any change in the ownership and/or operation of property subject to waste discharge requirements shall be reported to this Regional Board. Notification of applicable waste discharge requirements shall be furnished the new owner(s) and/or operator(s). A copy of such notification shall be sent to this Regional Board.

I, Roy C. Hampson, Executive Officer, do hereby certify that the foregoing is a full, true and correct copy of an order adopted by the California Regional Water Quality Control Board, Lahontan Region on February 8, 1985.



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ROY C. HAMPSON  
EXECUTIVE OFFICER



ATTACHMENT "A"

GOLDSTONE TRACKING STATION - ECHO SITE

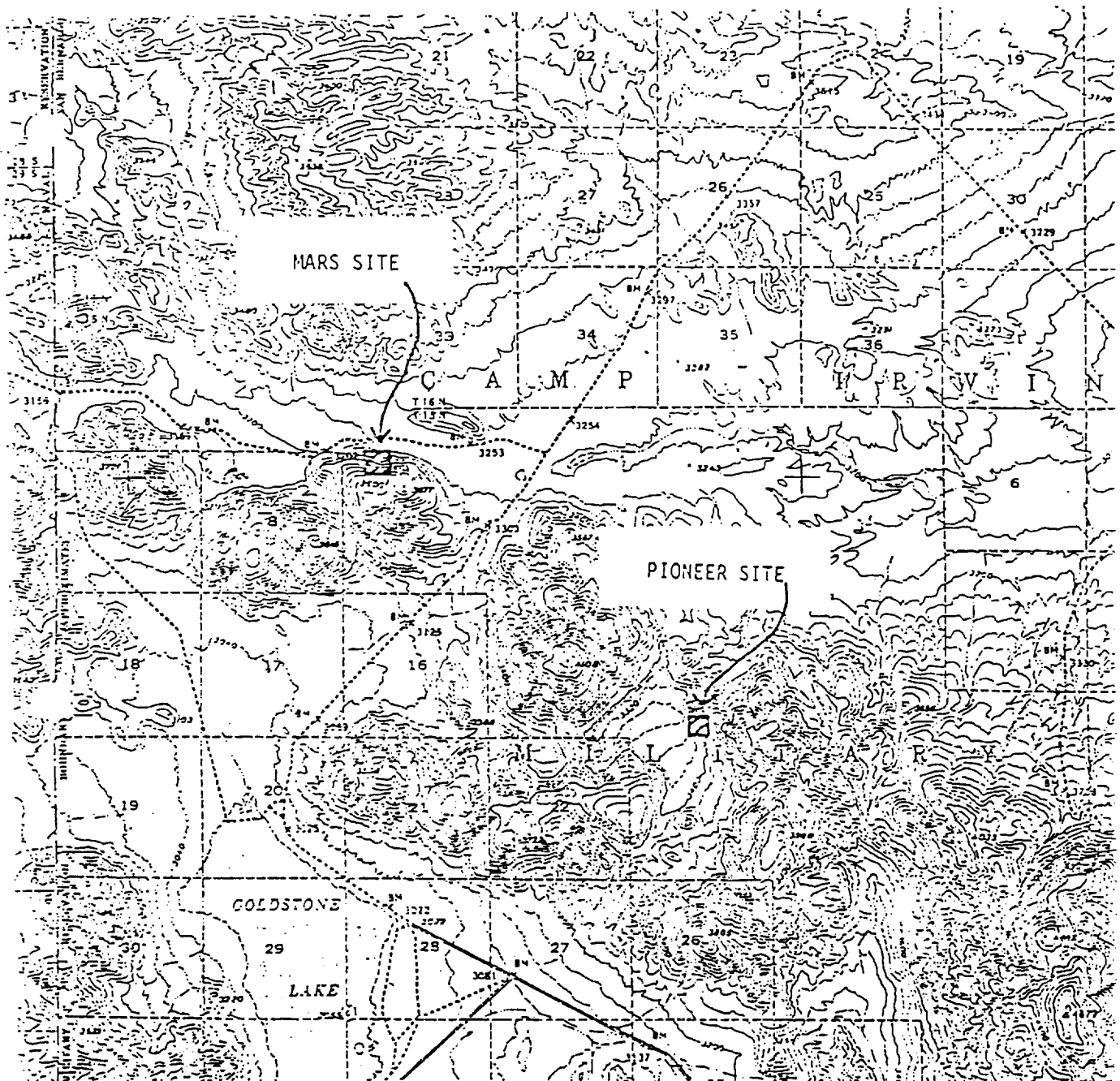
North of Barstow - San Bernardino County

Portion of the NE/4 Section 19, T14N, R2E, SBB&M

USGS Goldstone Lake 15 Minute Quadrangle

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ATTACHMENT "B"

GOLDSTONE TRACKING STATION - MARS & PIONEER SITES

North of Barstow - San Bernardino County

Mars - Portion of the NW/4 Section 9, T15N, R1E, S8B&M

Pioneer - Portion of the SW/4 Section 14, T15N, R1E, S8B&M

USGS Goldstone Lake 15 Minute Quadrangle

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
LAHONTAN REGION

MONITORING AND REPORTING PROGRAM NO. 85-7

FOR

GOLDSTONE TRACKING STATION  
ECHO, MARS AND PIONEER SITES  
San Bernardino County

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FLOW MONITORING

The following shall be recorded:

1. The average daily number of people working at each facility for each month.
2. The freeboard (distance from the top of the dike to the wastewater surface in a pond) measured each month in each pond. If a pond does not contain wastewater indicate that it is empty.

OPERATION AND MAINTENANCE

A brief summary of any operational problems and maintenance activities shall be submitted to the Regional Board with each monitoring report.

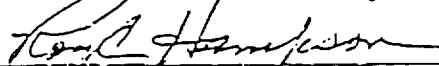
This summary shall discuss:

1. Any modifications or additions to the wastewater conveyance system, treatment facilities, or disposal facilities.
2. Any major maintenance conducted on the wastewater conveyance system, treatment facilities, or disposal facilities
3. Any major problems occurring in the wastewater conveyance system, treatment facilities, or disposal facilities.
4. The date and location of any septic tank and/or subsurface disposal system that is pumped. The volume of waste pumped, the point of disposal, and the person or company doing the work should also be recorded.

REPORTING

Annual monitoring reports including the preceding information shall be submitted to the Regional Board by the 15th day of the following annual period. The first report is due January 15, 1986.

Ordered by:

  
ROY C. HAMPSON  
EXECUTIVE OFFICER

Dated:

Feb. 25, 1985

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